ENGINEERING NEWS

THE new Rapid Transit Commissioners held the third meeting since their creation on Wednesday of last week. The New York Underground Railway Company, applied for permission to lay out a new route, beginning at Park Row and Broadway and running thence along Park Row, and up Elm street to Fourth avenue, conditional on Elm street being widened. If this is done, the Underground Railway Company say that they will build a four-track road, on a roadway 60 ft. wide, along the route indicated. The depth of excavation called for by the plans is 12 ft. but the height of the tunnel will be only 9 ft. 6 ins. There seem to be projects enough and commissions enough to provide New York with rapid transit facilities surpassing anything which the world has ever seen or dreamed of, but the projects are slow in materializing.

THE endless telephone litigation has resulted in another victory for BELL over an alleged pre-discoverer of the art of transmitting speech by electricity in a decision rendered in the United States Circuit in New York last week. In the mean time marvellous stories are told of the advantages of a new style of telephone which uses a broken instead of a pulsating current, but it will be time enough to take a deep interest in it when the alleged advantages of the system have been more completely demonstrated.

THE Westinghouse Air Brake Company is seriously contemplating the erection of works costing $500,000 at Rock Island, Ill., to save the heavy freights in western repair work and to fit western freight trains with air brakes, which it begins to look now as if it might be necessary to do on a vast scale in the not distant future.

IT is reported with every appearance of authenticity that several officers of the JAY GOULD roads have been acting on SHYLOCK'S motto "The villany you teach me I will execute, and it shall go hard but I will better the instruction." They have been actually buying cross-ties by the million at one price, and turning them over to the company at another price, omitting some of the formalities for such transactions which the law provides. It is a shameful performance, but it is not more shameful than very many of the methods by which the right to object to such little transactions has been acquired by their great chief, and hence it is only natural that the average man should find it easier to chuckle over such a turning of the tables than to feel indignant.

THE Pennsylvania Railroad Company has concluded to lay a mile of steel tie track on each of the four main divisions this summer. The ties will be 9 ft. long, and when laid entirely embedded in stone, the ballast being even with the rail on the outside of the track. The tie is 10 in. in width and is shaped thus ⌐¬, with chairs on top through which the rails are slipped. We presume the purpose of the experiment—and a very reasonable and rational one—is merely to acquire information for guidance ten or twenty years hence when the steel tie question becomes a real one. It is not likely that they have the least expectations of soon beginning the general use of iron ties. We also understand that an experimental mile of track is to be laid with 90 lb. rail and the regular London & Northwestern English chair.

A BRIDGE on the Vandalia line over White river, Ind., behaved very creditably under a derailed train. In some unexplained way a guard-rail became loosened and turned upward, so that it pierced the tender and derailed it with ten loaded cars behind it. Several tension and compression members were badly bent, but the guard-rails restrained the derailed wheels and the bridge managed to hold together.

THE Manchester Ship Canal seems at last on the point of emerging from the region of doubt and uncertainty and of going forward to completion. The opposition to it has been very strong and persistent, but the last bill has passed successfully both Houses of Parliament and received the royal assent, and the only condition imposed in committee, viz.: that £2 a share shall have been paid in on 300,000 shares before the preference shares may be issued is stated to be already fulfilled. It will be an important and novel work, practically carrying the sea-coast 40 miles inland.

THE New York Central & Hudson River are laying large quantities of their heavy 80-lb. rail section on all parts of their line, but the angle-bar joints are not acting very satisfactorily breaking in considerable numbers. They are but little heavier than those used for much lighter sections.

THE last report on the Mississippi jetties shows that they are still fulfilling their functions well. No dredging has been done for over four years, while the 26 ft. channel 200 ft. wide has been well maintained.

ANOTHER highway bridge went down under a traction engine on July 21, this time in Danville, Ill., killing one man, which makes four that we have noted within a few weeks as falling under a slight excess over usual loads.

TWO tests of street cars propelled by electric motors and storage batteries have been made lately, one in Philadelphia and one in New York, with, it is said, gratifying results. Another test from which we hope for still better results is to be made shortly in this city, and pending that test we postpone more elaborate record of these later tests. One thing appears to be pretty clearly indicated by past experience, that the only hope for a successful street car motor lies in electricity, and the surest hope for an entirely satisfactory electric motor seems to lie in the use of storage batteries, if we may judge by unsatisfactory results in Cleveland and elsewhere, although it is impossible to predict anything with certainty as to what may or may not be done with electricity.

RAPID TRANSIT is striking Chicago in the form of a projected underground belt railroad. The Metropolitan Railroad Co. was incorporated there on July 22 with a capital stock of $3,000,000, and it is to be operated by "steam, compressed air, electricity or other suitable power." As far as stated the plan is for a tunnel 35 ft. below the streets, with four tunnels on the principal streets, reaching all quarters of the city and running out into Cook county. The capitalization is ridiculously small for so ambitious a scheme. The incorporators are, ELI H. DOUD, JOHN MILLER, JOHN GRAY, HENRY W. LEMAN, JOHN S. MILLER and BEN. F. CHASE, all of Chicago. It seems a most impracticable scheme.

THE Inter-State Commerce Commission has in quick succession rendered three decisions of great value for correcting abuses of administration: 1. It has formally condemned the practice of paying commissions to ticket agents of connecting lines, as we noticed last week. 2. It has set down upon a preposterous claim of the Providence & Worcester Railroad that it was at liberty to give decided advantages to very heavy coal shippers, in Standard Oil fashion, with the plain effect of crushing out all small dealers. 3. It has set down upon the practice of allowing to commercial drummers *as drummers* lower rates than are allowed to other people, while carefully affirming the right of the railways to make any desired concessions in rates open to the whole public in favor of those who travel regularly or frequently. In all three of these decisions the Commission has only followed the plainest dictates of justice and common sense, and although the three decisions only affect directly as many single cases out of thousands of the same nature which might be brought before it, yet there can be no doubt that, after one or more reassertions of them at least, they will be generally accepted by the whole railway system, and three grossly improper abuses be done away with, as they could not have been by any amount of State legislation.

THE Sault Ste. Marie canal communication between Lakes Superior and Huron is dangerously approaching its limit of traffic accommodation and the late convention held in Detroit is intended to call public attention to this fact. The present lock, opened in 1881, is 60 ft. wide at the gates, 517 ft. long and has in it 17 ft. of water. Through this lock 7,424 vessels passed in 1886, an increase of 38 per cent. over 1885. Four vessels of average size can be locked together, as the lock is 80 ft. wide in all parts except at the gates, and the time consumed is one hour. Under the best conditions 2,976 vessels can be passed through in one month, while in July, 1886, 1,296 vessels actually passed. It is estimated that in 3 years the ultimate capacity will be reached, hence the present anxiety for appropriations for a new canal from Congress.

THE most serious railroad accident of the week was a tail collision, on July 27, between a freight and a construction train on the Chicago & Alton Railroad between Hopedale and Delavan, Ill. The construction train had been sent out to extinguish the flames on the Orendorf bridge, which was on fire, and having finished its work had started to return when the freight train ran into it. The engineer of the construction train claims that the engineer of the freight disregarded a signal to stop which he had shown at Hopedale. Both trains were badly wrecked. Ten men are reported killed, 4 fatally injured and 8 missing.

RUDOLPH HERING, Chief Engineer, and BENEZETTE WILLIAMS and S. G. ARTINGSTALL Consulting Engineers, have submitted their special report on the Desplaines Cut-off for the diversion of the flood waters of the Desplaines river and North Branch of the Chicago river, and recommended its immediate construction at a cost of $2,695,000. The report is voluminous, entering into a full detail of reasons and estimates of cost. With this work done, and not until then, a dam can be constructed across the Desplaines valley at Summit, and improvement of the South Fork of the Chicago river is also recommended at a cost of $653,000. Chicago will then have much greater immunity from contamination than at present, while the Chicago river will be better in its sanitary condition than for many years, and the navigation of the Illinois & Michigan canal will be improved. This work can be completed in two years.

DURING the week very extensive damages have been caused by floods and storms, especially throughout New England. Numerous railroad washouts are reported, and on the Fitchburg, Maine Central and Harlem railroads, trains have been blocked by washouts in front and behind. Traffic has been much interfered with. On the Green river in Massachusetts 23 bridges were washed away, and many mills and factories wrecked. The rivers all through the New England States are very full, and much country is flooded, as an effect of very heavy rain storms which have also caused much damage to crops. In New York and Pennsylvania there have also been serious floods, causing washouts and other damage. The dam of the water-works at Coatesville, Pa., burst, and the flood washed out several hundred feet of track of the Pennsylvania Railroad. A very large number of bridges are reported wrecked or damaged. Railroad washouts are reported from Arizona. Much damage has also been caused, and some lives lost, by lightning. At Philadelphia, sewers and water pipes were burst by the flood. Several railroad accidents are reported, due to the washouts, and more no doubt occurred.

ACCORDING to the forthcoming report of Captain POWELL, U. S. Engs., the jetty proposed for improving navigation over the bar at the mouth of the Columbia river in Oregon, is already showing good results. This jetty was commenced in July, 1884, and $97,902 have been expended upon it. It is to be about 4¼ miles long, and to cost $3,710,000; the greater portion being of stone and beton blocks, with wood and mattresses used wherever practicable. The channel required is to be 30 ft. deep at low water. To Dec. 31, 1885, the work done amounted to 1,000 lin. ft. of jetty, made of brush mattress costing $1.56 per cub. yd. weighted with 1,500 lb. blocks of stone costing $2.19 per cu. yd. On this is a jetty trestle costing $8.66 per lin. ft. This trestle carries two tracks of 30-lb. rails, on 10×14 in. stringers, bolted to 10×12 in. by 21 ft. caps bolted to 4 fir piles in a bent driven about 18 ft. The jetty including this tramway cost $18.25 per lin. ft. On a base of 36 to 45 ft.; 1,944 cub. yds. of brush mattress, and 3,346 cub. yds. of stone were used.

The Railway Advance into Asia.

The sketch map of Afghanistan and "thereabouts" presented with this issue, is based upon the latest and most accurate German map of this region published by von Petermann, of Gotha. The part of Asia represented will in all probability soon be the theatre of an interesting contest between England and Russia over the "protection" of Afghanistan, and to this end both nations are pushing railway construction, with the Russians somewhat ahead at the present writing.

The Railway Situation in Central Asia.

The Russian general, SKOBELEFF, in 1881, built a military railway from the Caspian Sea to Kizil Arvat to assist him in the conquest of that part of Turkestan. This road has now been extended by Gen. ANNEKOW, who commenced work in May, 1885, and in 18 months, with 1,300 soldiers, 1,000 native laborers, and 4,000 horses and mules, completed about 400 miles of fully equipped railway. This line hugs the northern boundary of Persia, where the mountain streams furnish water to a strip of land somewhat less desolate than the sandy desert just north of it, until Kaachka is reached. Then the line points towards Merv in the oasis watered by the Murghab river; and from Merv it strikes out boldly across the desert to the river Oxus, or the Amoo of older geographies. At last accounts the railway was finished to a point between the boundary of Buchara and the Oxus, but it is expected that the line to Samarkand will be completed late in the present year.

In connection with this Russian rail connection with Europe, now broken by the Caspian and Black Sea, another all-rail route is said to be actually under construction, which points towards Taschkent, north-east of Samarkand. This line will probably start from Orenburg, on the Ural, from which point there is now an unbroken rail connection with St. Petersburg and Europe generally. Orenburg lies in latitude about 51¾° N. and 55° E. of Greenwich, just north of the eastern boundary of the Caspian Sea. The route contemplated lies to the north of the Aral Sea and striking the Syr-darja, or Sirdarnia river, and follows this stream to Taschkent. Extension east from this last-named town, and Samarkand as well, is a vital part of the scheme, the objective point being supposed to be Kashgar, which will bring the road within the confines of the Chinese empire. The location of this part of the line is not as yet made public.

As shown on the map, the Russian railway system is now within 230 miles of the northern boundary of Afghanistan and within about 350 miles of Herat, with a comparatively easy country between for railway construction directly up the fertile valley of the Murghab river.

Now on the south of Afghanistan we have the English approach, passing from Karantschi or Kurrachee, on the Arabian Sea, up the Indus river to Schakar and thence into the mountain region lying between the Bolun Pass and Kandahar. The route contemplated and yet to be built is indicated by the line of black dots practically following the ancient

highway through the mountain passes. The route is a difficult one from a constructive standpoint, and, as we mentioned a few weeks ago, the English engineers have practically only *commenced* the detailed survey requisite to determine which is the best line. The Kojuk Pass (or Chadschak as our German map makes it) is said to be 7,000 ft. above the sea-level, and the present terminus of the line, which is now just beyond Quetta instead of Harnai as shown, is at an elevation of 5,600 ft. above the same datum. In this connection the *Indian Engineer*, of April 30, gives the following detail of the Bolan Railway, and also notes some very unaccountable vagaries of gauge in a strategical railway. The journal quoted says that the road has been opened for 120 miles over the Pass and is utilized for traffic from Rindli to Quetta, or about 80 miles. At Hirokh (or Harnai) which is 4,500 ft. above the sea, the Indian broad-guage of 5 ft. 6-in. ends, and we have 9 miles of narrow-guage "ghat-line" over the summit of the Pass. And here again the broad-gauge commences and continues for 25 miles to Quetta. The *Engineer* says that the conversion of this narrow-gauge line to the Indian standard is in contemplation. But it would require a year to do it, would cost a very considerable sum of money and would necessitate the fitting of 3 miles of the steepest portion of the road with a rack-rail and special engine. The same authority says that the present line has cost double the sum that a properly constructed line should have cost. This break of gauge is not peculiar, however, if all reports be true. The line running up the Indus and then across the north of India and down the valley of the Ganges to Calcutta is said to have several similar breaks of gauge in its length, a somewhat natural outgrowth of the conflict of gauges now going on in India.

While the Russians seem to be pushing towards the Chinese Empire by way of Buchara, the English are advancing towards the same objective point by way of Burmah and the Irrawaddy river. It is a long, very long, road from Cashgar to the Yellow sea, some 2,500 miles in round numbers and with a country intervening in Central Asia that is very unpromising for good location and easy construction. But it is an interesting fact to note that Cashgar, with which point the Russians will doubtless have railway communication in the near future, is as near as may be half-way between St. Petersburg and the eastern confines of China. The Celestials are even now discussing railway building, in their usual very deliberate way, and the pressure from the aggressive Russian from the West, and the equally pressing Englishman from the South may become so great that China will be forced into construction of railways on a vast scale simply as a means of self-defence. The Chinese have "cheap labor" in abundance, and can raise the capital to purchase the rolling-stock, or build it themselves under Western guidance, and if they once get started, the sons of the builders of the Chinese Wall may do wonders in railway building.

A very late Tiflis despatch to the *London Daily Times* says that the Russians are now pushing south from Merv. They said that they were going to Meshea for the "benefit of pilgrims;" but the same line practically leads to Herat for the benefit of Russia. The despatch states that quantities of railway material were accumulated near Merv, and that the Russians were "hurrying along with it."

METALLIC magnesium, that usually costs about $200 per pound, it is claimed can now be produced by the Grætzel process at from $6 to $10 per pound for wire and strips; and the manufacturers hope to lower this price to about $3 for the crude magnesium. It will then be close to German silver in cost and possesses many advantages over that metal.

THE rapid growth of Kansas City is indexed fairly well by the growth of its engineer department. In 1877 there was a City Engineer and four Assistants at a total cost of $4,500 per year. In 1881 the total staff was 12 men. Up to 1883 a single small office served for the whole staff. In 1887 there are 50 men on the staff at a total cost of $50,000 for salaries, and a suite of five large rooms is occupied. It is stated that during the past five years sidewalks enough to reach nearly to St. Louis have been laid.

The Transmission of Natural Gas Long Distances.*

BY GEO. H. CHRISTIAN.

The question of the pipage of natural gas long distances by its own pressure is one of great importance at the present time. We can hardly read a scientific paper that this subject is not spoken of, and various opinions expressed, but it is only by constant discussion that we can obtain a complete understanding of the subject and fully appreciate the future possibilities in this direction.

The practical questions of leakage, dangers from explosions and the controlling of gas under high pressures have been solved by those working in this field.

It is left for us to but demonstrate the possibility of conveying this fluid in large quantities great distances by its own pressure, to induce capital to flow into this channel of trade. It is claimed by many that there is a limit in distance soon reached beyond which the cost of plant in proportion to quantity of gas delivered will render it impossible to give more than a few cities in this country the benefit of this fuel; and we see daily instances of the effect of this view in manufacturers moving their factories to places where natural gas is found in abundance. In an issue of *Van Nostrand's Magazine* can be found a scientific discussion on the flow of compressed air, and formula deduced almost identical to the water formula "for flow of water through pipes." This article is from the pen of Prof. ROBINSON, of the State University.

You will find his formula, derived from the principle of adiabatic expansion of gases, to exactly coincide with results obtained by a formula which I shall use, and which is derived from considering the work done by the expansion and friction of the gas; these facts, I believe, clearly prove the correctness of both. We will not go into the mathematics of this subject, but consider the forces acting when gas is flowing, and determine analytically the results.

Let us take a pipe of large diameter and great length, connected with a number of gas wells, allow this pipe to fill and the terminal pressure to reach that at the wells. Now let us open a valve at delivery end, and ascertain the quantity discharged; which quantity will depend upon the following variables: The pressure of the wells and the length and diameter of your pipe line; the forces at work are expansion and friction, and it is the latter force we must determine.

From our knowledge of the flow of water through pipes, we have total head H in a line of pipe, equals $h + h'$ where h is velocity head and h' friction head. Now these are the only losses on the supposition that the gas maintains constant temperature. We can then, having given the initial pressure, distance and size of pipe, determine the friction, loss and quantity discharged. In applying the formula for discharge you will find that the friction loss in uniform diameter pipe line increases in a rapid ratio as you approach the end of your line, and that to pipe gas with least outlay of plant your pipe must be of variable diameter, and it remains to ascertain the degree of this increase; to do so let us look at the equation of friction, which is written thus:

$$F = CH\frac{L}{D}S = F.$$

C = constant.
F = total friction.
H = velocity head in pounds per square inch.
L = length in feet.
D = diameter in feet.
S = co-efficient of friction.

From this formula we see that the friction increases as the square of the velocity, inversely as the diameter of pipe and directly as the length; also directly as the quotient of the pressure in pounds per square inch above a vacuum divided by atmospheric pressure. Your pressure decreases as you advance from the wells, and your velocity increases; the density of your gas, however, decreases, so that your friction loss on this account will not increase as the square of the velocity, but more nearly as to the velocity. By increasing the diameter of your pipe to meet this increased velocity, and thereby maintaining a more constant velocity, you can keep your friction loss within small bounds.

To lay out a pipe line so that its friction losses shall remain within the pressure available, we have but to keep in mind this fact, that in steady motion the same weight of fluid must pass each cross-section in a unit of time, whether your pipe is of uniform or variable diameter. Let us, then, take an example: Suppose we are required to determine the cheapest line of pipe possible to transport 225,000,000 cu. ft. daily, and deliver same at terminus of line 300 miles distant from wells, having an available pressure at wells of 300 lbs. per sq. in. We will assume the initial diameter of pipe line to be 2 ft.; a discharge of 225,000,000 cu. ft. per day would be 2,600 cu. ft. per second. The area of pipe 2 ft. diameter is 3.1416 sq. ft. 2,600 divided by this area, 3.1416, equals 821. This divided by $\frac{314.7}{14.7}$ equals 39 ft. per second as velocity in first mile, and from the formula for friction for gas of specific gravity 0.6, the loss in friction for the first mile will be 5.2 lbs. Now, if we should continue our pipe 2 ft. in diameter for 10 miles, we will have a velocity in the tenth mile of 47 ft. per second, and a friction loss of 6.4 lbs., making a total loss for friction in the first 10 miles of pipe 58 lbs., and will leave you a pressure at the eleventh mile of 242 lbs.; here let us increase to 2¼ ft. diameter and continue this diameter for 30 miles; your velocity and friction loss in first mile will be 30¼ ft. per second velocity, and 2 lbs. per mile friction loss, and in the last mile of 2¼ ft. pipe velocity 41 ft. per second, friction loss 2.76 lbs. per mile, making a total loss of 70 lbs. in the 30 miles, and leaving a pressure of 172 lbs. at the forty-first mile point; here we will increase to 3 ft. diameter and continue same 20 miles. Your velocity in first mile will be 29.3 ft. per second, and friction loss of 1.15 lbs. per mile, and in last mile of 3 ft. pipe, velocity 34 ft. per second, friction loss, 1.38 lbs. per mile, making a total loss of 25 lbs. in the 20 miles, and leaving a pressure of 147 lbs. at the sixty-first mile point; here we will increase to 3¼ ft. diameter, and continue same for 15 miles, the velocity in first mile will be 25 ft. per second, and friction loss 0.6 lbs. per mile, and in last mile velocity 27 ft. per second, friction loss 0.68 lbs. per mile; total loss in 15 miles, 10 lbs., leaving a pressure of 137 lbs. at the seventy-sixth mile point; here we will increase to 4 ft. diameter and maintain same to terminus of your line, or for 225 miles, and your total loss in that distance will be 136.8 lbs., leaving 0.2 lbs. pressure to maintain the flow of gas there of 207 ft. per second.

Our pipe line beginning 2 ft. in diameter and ending 4 ft. will transport 225,000,000 cu. ft. every 24 hours, with an initial pressure of 300 lbs. per sq. in. This line, I believe, you will find to be the cheapest that could be built to do that work, but for other considerations it would be better to lay a double line of pipe for the more perfect protection of your consumers in case of accident to one line. Having calculated for a pipe of initial diameter of 2 ft., we can readily ascertain what initial diameter would be required using two pipes to convey the same amount of gas, and you would find that two lines beginning 18 ins. diameter and ending 3 ft. will deliver nearly the same amount, as the 2-4 ft. single line will do. I wish to show you a peculiarity of these friction losses. Let us take a pipe 4 ft. diameter and continue this diameter the 300 miles, and assume a discharge same as before, 225,000,000 cu. ft. daily, what initial pressure would be required?

Beginning at the terminus and working backward, we will find the losses thus:

	Mile.	Miles.	Lbs.
1st to	6th	6	14½
6th "	18th	12	17
18th "	36th	18	17
36th "	60th	24	17
60th "	90th	30	17
90th "	126th	36	17
126th "	168th	42	17
168th "	216th	48	17
216th "	270th	54	17
270th "	300th	30	8½
	300 miles.	Friction loss.	159 lbs.

The friction loss remaining the same for every additional increment of 6 miles, thus you would need but 160 lbs. of well pressure to transport 225,000,000 cu. ft. daily 300 miles through a pipe 4 ft. diameter throughout. Again you can readily obtain total friction loss in any pipe line of constant diameter, length and pressure given. Assume a discharge, calculate the friction loss in first mile, multiply this friction loss by the number of times in density the gas in first mile is above atmosphere, add to this the friction loss in last mile and divide this sum by $(\frac{PO}{P} \times 1)$. PO equals initial pressure above vacuum. $P = 14.7$ atmospheric pressure. Thus, for last example: Terminal velocity, 207 ft. per second, initial pressure 159 lbs. $\frac{159 + 14.7}{14.7} = 11.6$ The friction loss in first mile will be 0.3 lb. This multiplied by 11.6 equals 3.48 lbs.; friction loss in last mile 3.2 lbs.; adding $3.48 + 3.2$ equals 6.68 $\frac{6.68}{11.6+1} = 0.53$ lb. as average friction loss per mile, and for 300 miles 0.53×300 equals 159 lbs. as before. This renders quite simple what would otherwise be a tedious calculation. Let us now look into the cost of our pipe line.

The average pressure in the 10 miles of 2-ft. pipe would be 275 lbs. But since there would be times when the whole pressure of 300 lbs. would be on the whole length of 10 miles, it should be made sufficiently strong to safely withstand the same. The thickness of said pipe should be, if of wrought-iron or steel plate, ⅜-in. thickness, costing $25,000 per mile complete. The

* From Journal of Association of Engineering Societies, June, 1887.

2½-ft. pipe would also have to stand 300 lbs. pressure, and would have to be ⅞-in. thickness, and cost $37,000 per mile. Here an automatic governor should be placed in your pipe, so as not to allow a greater pressure beyond this point than 225 lbs. per sq. in., for if the pipe line was doing its full capacity, the pressure would be but 172 lbs., and less on the 3-ft. pipe. With 225 lbs. pressure, thickness of pipe would be ¾ in., and cost $37,000 per mile. Your 3½-ft. diameter would require to be ⅞-in. thickness, and cost $45,000 per mile. Here, again, an automatic pressure regulator should be placed to prevent the pressure beyond exceeding 160 lbs. maximum, and your 4 ft. would average in thickness throughout its entire length, ¾ in., and cost $30,000 per mile. This would make your pipe line net complete $10,000,000; add to this the cost of right of way, gas property, drilling of wells and city pipe system, and your total cost of plant would be nearly $16,000,000.

In the above estimate, I have assumed the pipe to be of wrought-iron boiler plate, double riveted, and to be laid above ground; and arrangements made for the contraction which must take place when the gas is turned on, either by using expansion joints or laying the pipe in a wavy line.

There is another material that could be used, which, I think, would be even cheaper than riveted work, and that is open-hearth or Bessemer cast steel pipe. This metal can be made in large amounts possessing a tensile strength of 60,000 lbs. per sq. in., and allowing a factor of safety of 10, you would have the same strength for each inch cross section as from a 3-in. cross section of cast-iron, and the weight would thus be one-third lighter than cast-iron, but heavier than boiler plate. These pipes ought to be made for 2¼ cts. per lb., or even less for such large pipe. It is not my intention to go into the detail of cost, but simply to show that a pipe line can be laid to carry a large quantity of gas a great distance, and at a cost within bounds. At first sight, the sum of $16,000,000 might seem to be so great as to prelude capitalists from investing in such a scheme, but when we estimate the receipts from sale of this gas, we will probably change our minds.

1,000 cub. ft. of natural gas contain 1,000,000 heat units; 1 bushel, or 80 lbs. of hard coal, 1,200,000 heat units. In burning gas for domestic purposes you realize 50 per cent. more of its heat than from burning coal, or your gas would be equal to 100 lbs. of hard coal. Hard coal in New York City or Philadelphia is worth $5 per ton, or 25 cts. per 100 lbs. If we should sell this gas for 12½ cts. per 1,000 cub. ft., it would reduce the cost of fuel to the consumer 50 per cent. The daily receipts from sale of 200,000,000 would be $25,000, or $10,000,000 per year. Allowing 15 per cent. on investment, you have remaining for yearly running expenses, improvements, repairs and sinking fund $7,750,000.

You may ask how is it that you figure such a large revenue, when in Pittsburg their total yearly revenue is but $2,500,000? The facts are, in Pittsburg, soft coal is used and sells for $1.25 per ton as against $5 in New York.

If you should pipe from Findlay Field to Chicago you could not realize over 10 cents per 1,000 cub. ft., but even here $8,000,000 per year revenue should pay handsomely.

Cleveland and Cincinnati are both nearer the gas territory, and the cost of plant very much less. These places must very soon avail themselves of this cheap fuel.

It remains, in my opinion, but to determine the permanency of the supply of this fuel to induce capital into this channel of business, and we can look in the near future for the building of vast systems of pipe lines to all manufacturing centers in this country.

There is another question I should like to have this society consider, and that is to determine the quantity of gas discharged from an orifice under heavy pressure.

Prof. ROBINSON, of this State, and others, went to Findlay last summer to make some measurements of the gas wells, and in his pamphlet he gives several examples of the pressures and discharges of same, also a most interesting account of his experiments with the Pitot tube for measuring dynamic and static pressures, and showing the very great accuracy of the Pitot tube. He settled this point by his experiments, that outside of the plane of the orifice there was no static pressure, while inside there was both static and dynamic; in other words, at the plane of the orifice the static pressure becomes dynamic and does work.

We will consider one of the examples given in his book, the Kurg well. The pressure at the end of a 4-in. pipe when the valve was full open was 15 lbs. per sq. in.; from this he calculates by the adiabatic formula the velocity of flow to be 1,513 ft. per second, and as the area of 4-in. pipe is 0.0873 sq. ft., the discharge per second would be 132 cub. ft., or 12,000,000 cub. ft. per 24 hours. What is the velocity in this case?

If we calculate the velocities of fluids of 0.6 specific gravity and 1.2 specific gravity, under pressures of 15 lbs. per sq. in., assuming each fluid as incompressible, the velocities would be 1,778 ft. and 1,244 ft.; if we add these and divide by 2, we have an average velocity of 1,511 ft. per second. This is the average velocity of flow; but is it as he makes it, the average velocity for a gas of 0.6 density? Is it not the velocity for a gas of average density between 0.6 and 1.2, which would make the discharge 18,000,000 instead of 12,000,000 cub. ft. per day? That it is surely more than 12,000,000 I think I can clearly prove.

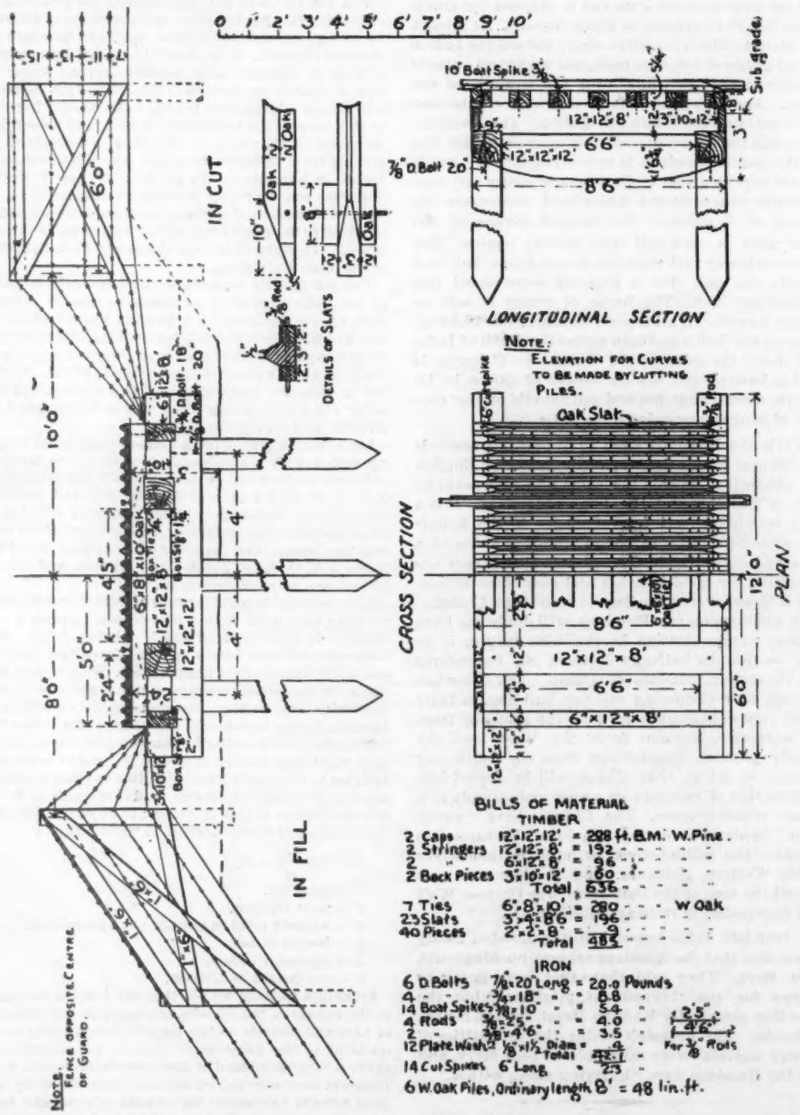
If the gas was incompressible and of specific gravity 0.6, its velocity of flow would be, under 15 lbs. pressure, 1,778 ft. per second, and quantity discharged 13,500,000 cub. ft.

From the formula $V = \sqrt{2gh}$ we see the velocity varies directly as the square root of the height, the height varies inversely as the densities, and therefore the weight of fluid flowing per second would vary inversely as the square root of the height, thus a greater weight of fluid would flow per second from a pressure of 1 lb. on water than from 1 lb. pressure on air, or from 1 lb. on gas of specific gravity 1.2, than from 1 lb. on gas of specific gravity 0.6, and that this would be inversely as the square roots of the heights, which in this case would be as $\sqrt{1} : \sqrt{2}$ or 18,000,000 cub. ft. per day. Again, take gas specific gravity 0.6 under 1 lb. pressure, velocity would be 456 ft. per second; assuming 1 sq. ft. area of orifice and 1 cub. ft. of gas, specific gravity 0.6 = 1 lb. in weight, the weight of flow would be 456 lbs. per second, gas at specific gravity 1.2 under 1 lb. pressure, velocity would be 318 ft. per second, and weight 318 × 2 = 636 lbs. per second.

Calculated by the adiabatic formula your velocity would be 430 ft. per second, and by Prof. ROBINSON'S method but 430 lbs., 26 lbs. less than 456 lbs.; which must be wrong. To me it would seem to be correct to calculate the velocity of flow due to pressure and density, multiply this velocity by the number of times the gas is in density greater than gas is at atmospheric density, then by area of opening, etc. Thus at 15 lbs. pressure its density would be 1.2 and velocity 1,244 ft. per second, multiply 1,244 by $\frac{1.2}{0.6} = 2 \times 1{,}244$, we would have $2{,}448 \times .0873 \times 86{,}400$, we would have 18,000,000 cu. ft. discharge per day.

There is still another method of proof. Calculate the initial velocity by this formula where the length of pipe is quite short:

$$V_o = \sqrt{\frac{g \times ct (P_o^2 - P_1^2)}{P_o^2 \left(\frac{4l}{d} + \log. \frac{P_o}{P_1}\right)}}$$



BILLS OF MATERIAL

TIMBER

2 Caps	12"×12"×12'	= 288 ft. B.M.	W. Pine.
2 Stringers	12"×12"×8'	= 192	"
"	6"×12"×8'	= 96	"
2 Back Pieces	3"×10"×12'	= 60	"
	Total	636	
7 Ties	6'×8"×10'	= 280	W. Oak
25 Slats	3"×5"×8'6"	= 196	"
40 Pieces	2"×2"×8'	= 9	"
	Total	485	

IRON

6 D Bolts	⅞×20 Long	= 20.0 Pounds	
4 "	¾×18" "	= 6.8	
14 Boat Spikes	⅝×10 "	= 5.4	
4 Rods	⅝×25" "	= 4.0	2'5" / 4'6"
2 "	⅝×4'6" "	= 3.5	
12 Plate Washers	⅛×1½" Diam	= 9	For ⅝" Rods
	Total	48.7	
14 Cut Spikes	6" Long	= 2.3	

6 W. Oak Piles, Ordinary length 8' = 48 lin. ft.

Standard Cattle-Guard—Kansas City & Omaha Railroad.

$g = 32$, $ct = 47{,}000$, d = diam. in feet, l = length of pipe in ft., and s = coef. friction, .006, P_o and P_1 = initial and terminal pressures pers quare foot above vacuum.

The terminal pressure in this case is 15 lbs. or 29.6 lbs. above vacuum; the initial pressure say for a length of 10 ft. can be figured by calculating the friction loss in that distance; the following formula will give you the weight of the fluid flowing per second:

$$w = \frac{n}{4}\sqrt{\frac{g\, d^4 (P_o^2 - P_1^2)}{\left(\frac{4l}{d} + \log. \frac{P_o}{P_1}\right) ct}},$$

where $n = 3.1416$.

If you will work out by this formula you will find the weight of fluid flowing per second to be 9.6 lbs. which would be the weight of 210 cu. ft. of gas, specific gravity 0.6, or a discharge of 18,000,000 cu. ft. per day.

[Mr. GEORGE WESTINGHOUSE, Jr., has taken out a patent for a pipe mine such as suggested herein, as elsewhere given.—ED.

Standard Cattle Guard.

We begin the publication of a number of standards of the Kansas City & Omaha Railroad with a drawing of its standard cattle-guard, which strikes us as among the best designs for that purpose. Masonry cattle-guards as a rule are wretched things, besides which, they are practically out of the question throughout a vast region of the West. If built very solidly, out of heavy blocks of fine cut stone, and protected above by a cushion of wood, they are tolerably durable, but the ordinary rule is that cattle-guard masonry, instead of being the best of any, as it should be, is about the worst, and shakes to pieces as soon as trains begin to run over it. Moreover, the pit cattle-guard is open to serious objections, whether of wood or stone. While perhaps the most effectual of any, regarded simply as a cattle-guard, it gives a derailed car no chance, and there have been instances in plenty in which they have proved a means of destruction by large animals falling into them when pursued by a locomotive or otherwise.

On the other hand the purely slat cattle guards, of which a great variety have been invented, both of wood and iron, and which consist merely of something laid on the ordinary ties, are open to the objection that they fill up with snow, unless cleaned out, and that they sometimes trap cattle which do not realize what they are until they are upon them. For this reason a pit of some kind is desirable. For the sake of safety to trains, ties above the pit are desirable, and if ties are used, longitudinal slats are essential to keep cattle off. This gives us the guard illustrated, the most serious fault of which appears to be that the ties are unnecessarily. cut off to 10 ft. long when they might be 11 ft., giving so much more safety to trains. The mud sill or box cattle-guard is an abomination which should never be used, since it often settles badly and rots chiefly out of sight, while necessarily fatal to a derailed train.

Long-Distance Gas Distribution.

Mr. GEO. WESTINGHOUSE, Jr., has just taken out a patent for an improvement in natural gas pipe mains, similar to that suggested by Mr. GEO. H. CHRISTIAN in his paper published in this issue which seems so obvious an improvement that we can only wonder it has not been done before. The specification being unusually full and interestng, we reproduce a large part of it:

"In the distribution of natural gas in pipes from the wells to distant places of use, there is a very considerable loss in pressure and velocity, by reason of the friction against the sides of the conduits.

"In laying the lines, three important things have to be considered—the cost, the loss from leakage, and the danger resulting from carrying a high pressure of gas. By reason of the loss resulting from the friction the quantity of gas which can be delivered from a pipe of given diameter diminishes relatively to the distance from the well to the terminus of the pipe, according to the well-known law governing the flow of fluids under pressure, so that the distance at which a given quantity of gas can be delivered, depends upon the pressure at the well and the size of pipe. The pipe of course must be of sufficient strength to resist the pressure. In a pipe line of uniform diameter of 8 ins., 20 miles long (being the length and sizes of the lines laid between Murraysville and Pittsburg,) having a pressure at the well of 300 lbs., the reduction of pressure due to friction is about 6 lbs. to the mile in the beginning, gradually increasing, according to the laws governing the flow of fluids, to a loss of 20 lbs. or more per mile. At 300 lbs. pressure each cubic foot of gas is equal to 20 cub. ft. at atmospheric pressure. If the gas-main, 30 miles long, having an area of 1 sq. ft., so that each foot in length would be a cubic foot, had an initial pressure of 300 lbs. per sq. in., the pressure at a point 5 miles distant from the delivery end would be about 180 lbs. per sq. in., and, the pipe being of uniform size, the gas which at first occupied a space 1 ft. in length would at the reduced pressure occupy 2 ft. in length.

"It was the practice before the date of my invention to lay lines of uniform diameter from the well to the point of distribution, and when it was desired to increase the quantity of gas to lay an additional line. The pipe used previous to date of my invention varied from 5 to 8 ins. in diameter.

"The use of a pipe of uniform size necessitates a very high pressure throughout the greater portion of the line, with a consequent loss by leakage, which is great when the pressure is high, and the liability of bursting the pipes and fittings.

"Where a considerable quantity of gas has been required, the cost of constructing a plant of pipes of uniform size has been a serious disadvantage to the gas companies, and consumers have been obliged to pay an increased price for the gas, because of the increased cost of the plant needed for its supply. The quantity of gas carried through a line varies approximately, according to the square of the pressure, and consequently a line carrying 75 lbs. pressure will take nearly one-half the quantity of gas through that it would at 300 lbs. pressure; and, again, the quantity of gas carried through pipes of the same length but of different diameters varies according to the square root of the fifth power of the diameters of the pipe. Taking two sizes of pipe—an 8 in. and a 16 in., for example—the 16 in. has at the same pressure about six times the carrying capacity of an 8 in., or with one thirty-sixth of the pressure will carry the same quantity.

"The purpose of my invention is to provide an improved system of gas-distribution, whereby provision is made for the reduction of the average pressure carried through the line, an increased delivery obtained, the loss and danger from leakage and the liability of pipes and fittings to rupture lessened, and the first cost of the line reduced. To this end I increase the size and capacity of the gas-conduit at successive intervals, making its size at the well relatively small, and enlarging it progressively at one or more remote points, so that as the pressure diminishes the capacity of the conduit is increased.

"Theoretically my invention is illustrated by a conduit made in form of a hollow cone, of which the apex represents the supply, and the base the delivery end; but in practice I do not make this increase in capacity so regular.

"The advantages of enlarging the pipe is not only to lessen the average general pressure through the line, but also to provide a considerable reservoir capacity, and at the same time to greatly accelerate the flow of the gas from the well to the points of distribution.

"The following will illustrate its practical application: Suppose a gas-line 9.15 miles in length, in which the pressure diminishes from 319 lbs. at the well to 65 lbs. at the other end. The first 2.84 miles of the pipe, in which the gas is reduced to 185 lbs., may be composed of one 8 in. main. For the next 2.75 miles, in which the gas is reduced to 132 lbs., one 10 in. conduit may be employed, and one 12 in. conduit for the next 3.84 miles, in which the pressure is reduced to 65 lbs. These figures are given merely for the purpose of illustration, and are taken from a gas line now in successful use which has been constructed in accordance with the principles of my invention.

"The principal advantage of my improvement consists in the fact that, while the average pressure of the gas in the line is greatly reduced, and leakage and danger lessened, the volume of the gas delivered is enormously in excess of that which could be delivered by a pipe line of the same cost and length and of uniform capacity throughout. The friction is reduced and expansion is provided for. It is desirable that the normal pressure should be greatly reduced at the point of utilization. This I accomplish in the conductor-pipe without the special provision of holders, tanks, or regulators, and without unnecessary loss of velocity and volume by friction.

"The saving of expense and cost of pipe resulting from the use of my improvement is very great, especially on long lines. Near the well, where, by reason of the great density and pressure of the gas, only a small pipe can safely withstand the pressure, the pipe or pipes are of relatively small size and cost, and the larger and more costly pipes are used only as the diminution of pressure and density at remote points necessitate larger conduits. The general pipe capacity has to be determined by the necessities of each case."

On Sifting Earth.*

BY EUGENE FLACHAT in *Memoires de la Société des Ingenieurs-civils*, 1886, p. 507.

It has been proved that concrete manufactured with the coarse grain sand dug from pits is more resistant than concrete made with river sand. Thus two briquettes made respectively with pit-sand and river-sand in the same proportions, broke under the following stresses:—500 lbs., and 484 lbs., in the ratio of 1.22 to 1. A concrete manufacturer has, for several years past, rather than be forced to search for sand-pits, washed his supply of sand out of common earth. By this process, besides separating the sand, he collects also the pebbles and gravel, and precipitates the humus; or vegetable earth.

The apparatus employed for this purpose consists of a cylinder about 3¼ ft. in diameter, made of sheet copper, which is pierced with holes of different diameters, grouped in successive zones each of 3¼ ft. in length, and arranged in the order of the sizes of the holes. The first zone has very small holes; the last has holes 2.36 inches in diameter. The material discharged from each zone is collected in a zinc receptacle below. The shaft or axel of the cylinder is hollow, and is perforated for the conduct and emission of water under pressure. The cylinder with its shaft is revolved by hydraulic power at the rate of one turn per minute. The earth is introduced—a shovelful at a time—at one end, corresponding to the smallest holes, and is passed through the cylinder towards the other end by an internal screw. The earth, under the influence of water projected from the hollow shaft, and also from a longitudinal perforated pipe above the cylinder, is gradually separated from the gravel, which is perfectly washed.

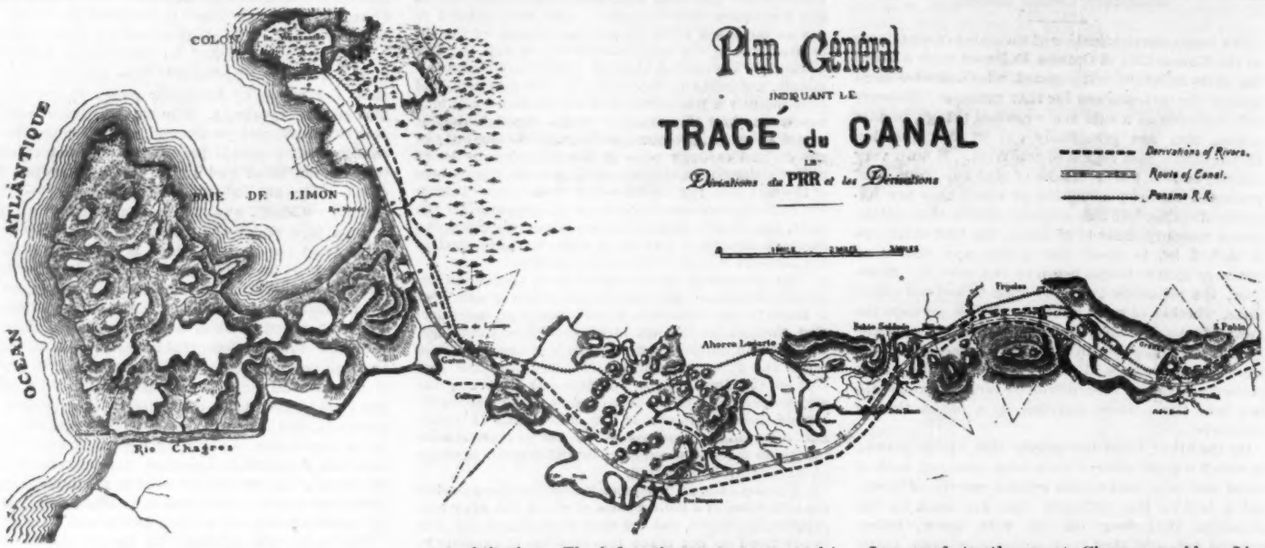
The gravel is thus separated and classified, and that of the last zone serves for road-making, or for the manufacture of concrete for the foundations of works of art. The water used for washing, charged with fine sand and vegetable earth, is collected in two semi-cylindrical troughs alternately, in which it is constantly agitated by revolving blades. The fine sand is gradually deposited in the troughs alternately, and the water, holding the vegetable matter in suspension, is passed through a series of basins in which the earth is deposited, and returns clear to the river. The fine sand is used in the manufacture of cement-mortar. The humus is much appreciated by agriculturists and kitchen gardeners.

This apparatus depends, for its satisfactory performance, on an ample supply of water, and it can only be economically employed where hydraulic power is available for driving the apparatus, as well as for raising the water for washing. The economy of the process has led to a considerable reduction of the price of cement pipes, with improvement of their quality. The proceeds of the sale of the gravel and vegetable earth cover the cost for labor.

* Abstract of Papers; Inst. Civil Engineers.

Lightning Rods for Tall Chimneys.

Prof. MICHAEL FARADAY says that the conductor should be of ½-in. copper rod, and should rise above the top of the chimney by a quantity equal to the width of the chimney at the top. The lengths of rod should be well joined metallically to each other, and this is perhaps best done by screwing the ends into a copper socket. The connection at the bottom should be good; if there are any pump pipes at hand going into a well they would be useful in that respect. As respects electrical conduction, no advantage is gained by expanding the rod horizontally into a strap or tube—surface does nothing; the solid section is the essential element. There is no occasion of insulation of the conductor for this reason. A flash of lightning has an intensity that enables it to break through many hundred yards perhaps miles of air, and therefore an insulation of 6 in. or 1 ft. in length could have no power in preventing its lead to the brickwork, supposing that the conductor were not able to carry it away. Again, 6 in. or 1 ft. is so little that it is equivalent almost to nothing. A very feeble electricity could break through that barrier, and a flash that could not break through 5 or 10 ft. could do no harm to the chimney. A very great point is to have no insulated masses of metal. If, therefore, hoops are put round the chimney, each should be connected metallically with the conductor, otherwise a flash might strike a hoop at a corner on the opposite side to the conductor, and then on the other side on passing to the conductor, from the nearest part of the hoop, there might be an explosion, and the chimney injured there or even broken through. Again no rods or ties of metal should be wrought into the chimney parallel to its length, and, therefore, to the conductor, and then to be left unconnected, with it. The rod may be close along the brick or stone, it makes no difference. There will be no need of rod on each side of the building, but let the cast-iron hoop and the others you speak of be connected with the rod, and it will be in those places at least, as if there were rods on every side of the chimney. A three-fourth rod is no doubt better than a half-inch, and, except for the expense, I like it better. But a half-inch has never yet failed. A rod at Coutt's browery has been put up 1½ in. diameter; but they did not mind expense. The Nelson Column in London has a half-inch rod—three-fourths is better. I do not know of any case of harm from hoop-iron enclosed in the building, but if not in connection with the conductor I should not like it; even then it might cause harm if the lightning took the end furthest from the conductor.



The Panama Canal.

From the report of Lieut. KIMBALL, which is noticed in another column, we extract the accompanying map and also the following notes which seem to convey information more or less new in regard to special details of the work. Although almost every one by this time has made up his mind as to the probable chance for completion of the canal in our generation, yet we may be mistaken, and at the most one cannot help feeling interest in the details of so grand a work. The map herewith is the most definite and clear which we have been able to obtain and alone brings out clearly why progress has been no greater and why the future of the work seems so dark.

The most striking fact on the map is the enormous amount of changing of river beds to be done, only a small part of which, the changes near Panama, have yet had any considerable work done on them, and those with discouraging results which we will shortly detail. As regards the great feature of the project, the Chagres *barrage* or dam, it is known that no definite plans or surveys have even yet been made, but the account of the plan for constructing it which is meeting most approval will be read with interest, as the only definite proposition which has come from the work:

THE BARRAGE.

"The general plan of operation, as kindly explained to me by the Director-General, is as follows:—To dredge and excavate down to the rock, which lies at from 10 to 20 ft. below the surface of the ground, except in the bed of the Chagres, where it is 40 ft. below the surface, and then on the rock foundation, dump broken rock from Emperador and other convenient cuts, until a height of 167 ft. is reached. The barrage is to have a base 1,320 ft. wide, and an exterior slope of 4 to 1, revetted with the heavier rock. On the basin side of this mass of rock, clayey earth is to be dumped and allowed to take its natural slope, the idea being that the pressure of the retained water will seal the dam by forcing clay into the interstices of the dumped rock, and that the sealing will also be aided by deposits brought down by the river. The outlet of the basin formed by building the dam is to consist of a tunnel cut through the Cerro Azul to the left of the Cerro Santo Cruz, which last is to be the support of the down-stream end of the dam. This tunnel is to have a diameter of about 20 ft., and is to be lined with iron; whether of circular or oval section is not fully decided. The tunnel will be prolonged by a cut to the bend of the Chagres just above Cargo Plata Island, near K. 44, and the length of the whole from the basin side of Cerro Azul to the Chagres will be 1,640 ft., with a fall of 30 ft., the inner orifice of the tunnel lying between 82 ft. and 102 ft. levels. The deflections of the upper Chagres are intended to contain the outflow from the basin and the left water-shed.

"According to this arrangement the surface will never fall below 82 ft. level, and the outflow will necessarily depend upon the height of the water within the basin. In regard to the capacity of the basin, I was informed by the Director-General that complete surveys had not been made, but that levels and contours had been run sufficiently far to show a basin capacity of 3,000,000,000 m. c. between levels 82 ft. and 164 ft., with an indefinite amount more beyond the points to which surveys had been carried. With these data, and an assumed inflow of 1,600 m. c. per second, M. FAGENSTECHER made some calculations in the Bureau of Technique last year, for the purpose of determining the basin conditions during floods, and kindly furnished me with the results of his work, which are appended, and from which it would appear that it would require nearly nine days of exceptionally heavy and continuous floods, after the water has risen enough to cover the inner orifice of the tunnel, to fill 40 per cent. of the basin space between 82 ft. and 164 ft. levels; that the outflow through the tunnel would be about 26 per cent. of the amount retained; and that the surface of the water would be 33 ft. below the top of the dam. The inflow of 1,600 m. c. per second is assumed from the discharge of the Chagres at Gamboa at extreme high water, as determined by Colonel TOTTEN in 1857, and is used as a basis of calculations, since it is the highest recorded. The observations made by the canal company would show that this is a much greater inflow than can be expected, the Chagres discharge at Gamboa during the extreme high water on the 25th November last, being only 954 m. c. per second. From the figures above it would seem that there are large margins of safety in the contemplated plan for the retention of the waters of the Chagres, both as regards the strength of the dam and the capacity of the basin; and I was assured by the Director-General that no engineering difficulties with the Chagres problem were feared, that it was only a question of the magnitude of the work, although the details of fixing the base of the dam in the present bed of the river had not been determined upon."

We have briefly discussed the chances of success under this plan on another page. It will at least be a grand feat of engineering if so simple a plan can be made to succeed on so large a scale.

The first considerable deviation of channel attempted was that shown on the map at the extreme southern end of the canal, and is thus described:

"The deflection of the Rio Grande from K. 55.4 to the Quebrada Honda was finished last season, all but about 10,000 m. c. a small proportion of which was rock: but since the rains, more than 30,000 m. c. have moved into deflection, the whole bank slipping in many places upon a substratum of greasy gray clay. The slips are not earth slides from the top of the bank, but rather movements of the whole hillside, which in some places carries one bank almost intact across the cut with the top surface unbroken, and with the vegetation undisturbed. There is a great deal of this slipping clay at the Colon end of Paraiso section, which will give great trouble as the work progresses. The Panama Railroad embankment at this place has always given trouble, but not so much so as since the Culebra Paraiso excavations have begun. It appears that the water once carried off by the steep hillsides matted with grass roots, now, from the earth being cut, seeps through and wets the clay, which then acts as a lubricant under the superimposed mass. The deflection for the railroad has been partly cut along the hillside toward Pedro Miguel. When it is considered that between Cerro Culebra and Cerro Coco, the canal, the deflection of the Rio Grande, and the deflection of the the railroad are to lie close together with the bottom of the deflection 164 ft. above the bottom of the canal, and the railroad 65 to 100 ft. above the deflection, and that there is a substratum of greasy clay all along the line, it would seem as if both the deflection of the Rio Grande and the deflection of the railroad must slide into the canal. The Director-General informed me in answers to inquiries on the subject that the difficulty would be met by surface drains made with dumped rock along the bank faces. The effect of the move of the soil was very curious; at one point the bottom of the deflection cut had risen 3 m. where the greasy clay had forced itself underneath, and at another I saw a surveying picket which had moved out of line 2.5 m. where there was no break in the top soil.

"Piles to anchor the railroad embankment, though driven vertical, were standing in the soil at an angle of 45 degrees. Along the canal there is a little terrace work in rock, and at Pedro Miguel a system of tunnels and large blasts is in use instead of the hand drilling and small blasting usually noted along the line."

The report states the already well known fact that much of the work excavated along the Chagres valley is being washed back by rains, expresses surprise at the small tools used and absence of power drills, and makes the very sensible suggestion that hydraulic mining methods might readily be used for a large amount of excavation, except that the powers that be will not consider it. The harbor plans are criticized as unnecessarily elaborate, but that is a side issue. The fact that the excavation has been confined so far to the easier part of the work, for the purpose of showing as large a cubic total as possible is specifically brought out.

In regard to the great Chagres problem, Lieut. KIMBALL shows, we cannot but think, his complete unfitness to judge of strictly engineering problems in the italicized words of the following quotation:

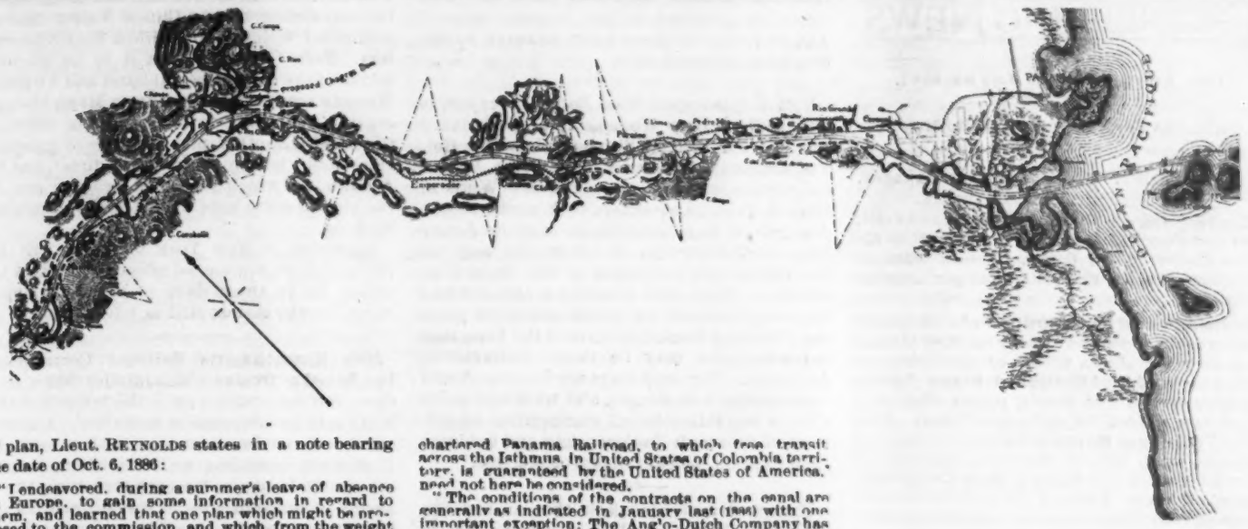
THE CHAGRES PROBLEM.

"The plan for the great dam already given seems to me quite sufficient. *Indeed I do not understand the necessity for excavating for a foundation* since I cannot conceive that the river could greatly displace a mass of rock dumped on the soil and in the bed. *The slope at the Gamboa is not sufficient to greatly aid the sliding of the rock, if it were dumped and the current allowed to cut the soil from underneath it, and consequently the rock would only sink until it found a solid foundation.* Even if in building the rock were somewhat displaced, it would be only a question of dumping more. When built, no pressure of the water could push *down* a mass ten times as wide as it was high, nor can I conceive of its pushing such a mass *along*. Mr. MENOCAL, in his report, speaks of the grave engineering difficulties in building this barrage, but I understand that he was then speaking of the first project for a masonry dam. The enormous amount of work necessary for the construction of a barrage [say 12,000,000 c. m. or 15,000,000 cu. yds. ED.] at least 40 m. high, 400 m. wide, and more than a mile long is apparent, but the engineering difficulties are to me not at all patent. That the basin will be ample for holding the floods, till the water can be drawn off through the tunnel, there seems to be no doubt. In fact, as regards the barrage and basin, the margins of safety are fully large enough from my point of view. It should be borne in mind, in this connection, that the great rises in the Chagres do not mean an immense discharge. The floods at Matachin are of short duration, showing that they result from large local rainfall, but not from extensive water-shed. The accompanying tracing of the section of the river at Matachin at the time of the great flood on the 25th of November last, illustrates the rapidity of rise and fall—of the comparatively small amount of discharge there would be in ten days, although very great for one or two. The rise and fall of the river at Gamboa depends very little upon the rainfall there, not even when the fall for a month is considered; for example, last year the greatest monthly rainfall was in September, and was in the 19 rainy days of the month 408.9 mm., the average height of the river being 16.28 m., and the highest water 18.33 m. In the 19 rainy days in November, the fall was only 336.30 mm., and the lowest water was 15.70 m., while the highest was 23.72 m. The rise was very rapid at the time of the flood.

"Dead low water at Gatun in the dry season is 14.85 m. I have been particular in speaking of the flood, because it is the highest there has been for seven years, and, therefore, a good example of what may be expected and of what the basin may have to hold. It is evident that the basin would easily have controlled the water coming down in that flood. With the barrage built, the deflections cut, and the embankments in place, the Chagres problem can, I think, be solved. WINSLOW speaks of the necessity of solid embankments at points where the canal crosses the Chagres at San Pablo, because at times the river rises 30 ft. at Barbacoas. It is true that the river does so rise, but if the basin at Gamboa holds the surplus water and sends down only 400 m. c. s. through the deflections, the duty of the embankments will be to resist, not the torrent rising 30 ft. in a night, but the stream corresponding to not more than 400 m. c. s., no matter what may be the condition of floods above the dam. The embankments must be solid enough to resist the tunnel outflow, but they need be only high enough to bring the wide bed cut off to the section of the deflection. On the whole it seems to me that the company has found the solution of the Chagres problem in theory, but the work necessary to put it in practice should have been some of the very first undertaken, when as a matter of fact it is hardly begun. Nearly all of the deflections are to be cut, and all of the embankments and barrage built."

Whatever may be thought of the proposed French plan of building the dam, which we have briefly discussed on the editorial page, the above suggestion to dump the material on top of the natural surface is certainly a wild one, for reasons summarized elsewhere.

Thinking that M. LESSEPS' promises to open the canal in 1889, might be based on proposed changes



of plan, Lieut. REYNOLDS states in a note bearing the date of Oct. 6, 1886:

"I endeavored, during a summer's leave of absence in Europe, to gain some information in regard to them, and learned that one plan which might be proposed to the commission, and which, from the weight of the authority making it, would seem to have a good chance for adoption, was in general terms as follows: to temporarily abandon the sea-level idea and carry the water between the 35 m. level and the 40 m. level from *K.* 25 near Bohio Soldado to *K.* 58 near Paraiso by means of dams across the Chagres and Rio Grande respectively, at the points mentioned; to thus make a lake with a least depth of 5 m. from the Bohio Soldado dam to Obispo, to excavate the necessary amount to carry 5 m. of water through the Obispo, Emperador, and Culebra sections, and to carry the same depth of water at sea level from either dam to either ocean by dredging; to allow the Chagres and all other streams between the dam sites free access to the lake; to provide for the ordinary flow by deflections, and for the extraordinary flow, or floods, by taking the excess over the gates of the locks or through the locks themselves —it being estimated that the traffic on the canal would thus be interrupted, but a day or two each year.

"Granting that the plan be practicable, that the dams will stand, that the feed-water during the dry season will be sufficient, that the rolling high-lift lock gates will function properly, and that the contours are not such as to require extensive side dams; remembering that much of the dredging from the Atlantic to the Bohio Soldado dam site is already done and that there are few difficulties to overcome between Paraiso and the Pacific; keeping in mind the comparatively large cubic extract above the 40 m. level, already out of the Obispo, Emperador, and Culebra sections, and allowing that the work will be ardently pushed, it is evident that the *opening* of a five-meter deep waterway across the Isthmus might take place in 1889 or in 1890.

"The object of carrying so shallow a water way across the Isthmus becomes apparent when it is remembered that dividends on earnings take the place of interest on shares 'after the opening of the canal' —whether it be a five-meter deep water-way using lift locks, or a nine-meter deep sea-level canal that is opened to traffic.

"It is entirely within reasonable limits to suppose that, after the provisional five-meter deep lock canal is established, it will be deepened to the nine meters required for practicable transit, and that then the temporary expedient of using locks and dams will become the permanent scheme of the enterprise. Such a scheme might prove very attractive; for, by its adoption, the excavation of the most difficult thirty-five meters of the most troublesome thirty-three kilometers of the canal would be avoided, the problems of the control of the Chagres and of the sliding substratum at Paraiso would be solved, and the the tidal locks and basin at Corozal rendered unnecessary.

"Possible diplomatic difficulties arising from the flooding out, by a French corporation, of the American chartered Panama Railroad, to which free transit across the Isthmus in United States of Colombia territory, is guaranteed by the United States of America, need not here be considered.

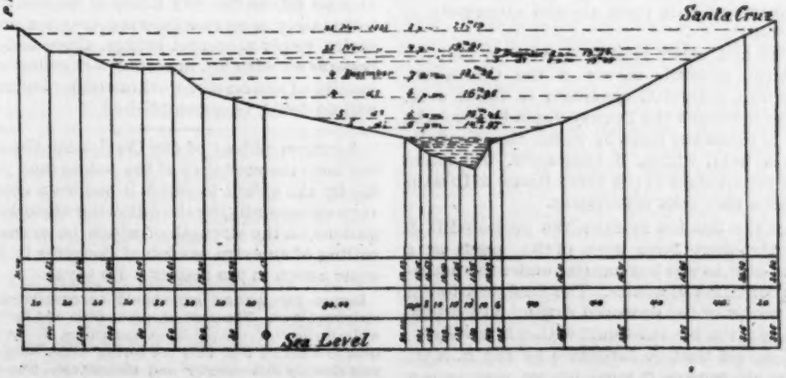
"The conditions of the contracts on the canal are generally as indicated in January last (1886) with one important exception: The Anglo-Dutch Company has withdrawn from the work at Culebra, and the contract for that section has been taken by a Parisian syndicate, with M. BUNAU-VARILLA, the director-general of last year, in charge of operations. As he has plenty of capital behind him, great results may be expected from the efforts of a man of such marked and well-known ability, such energy, courage, and perseverance. M. BOYER, *Inspecteur des Ponts et Chaussées*, who succeeded M. BUNAU-VARILLA in the director-generalship of the canal, fell a victim to yellow fever a few months after his arrival on the Isthmus, and the position is now held by M. JACQUET, *Inspecteur des Ponts et Chaussees.*"

This radical project, however, which we give in full, as it may yet be adopted, was rejected by the Technical Commission early in the present year, as an appended note states, bearing date of May 24, 1887.

On the great question of "probable date of completion," Lieut. REYNOLDS states that he sees no reason why, after the Chagres is controlled, the annual cube should not reach 20,000,000 c. m., although it has never yet reached 8,000,000 c. m., the total so far removed (including a rough estimate for 1886 and part of 1887) being some 28,000,000 c. m. in 6½ years, and the total to be removed 127,000,000 to 150,000,000 c. m. Lieut. REYNOLDS concludes that he is "strongly impressed" with the idea that the necessity of finishing the canal is likely to be apparent by the time all funds now available have been expended.

Profile of the Chagres at the 44.7 Kilometres.

Floods of 25th November, 4th and 5th December 1885.



Le Genie Civil, of July 9, illustrates the "helicoidal lift," or elevator, designed for the conveyance of passengers to the top of the 1,000 ft. Eiffel tower at the exhibition of 1889. The cage is two-storied and is to carry 100 passengers at a time. At its base five wheels at the end of radial arms run on a screw-like track fastened on the inside of a circular tower of lattice construction. The wheels are made to revolve around a central axis in the cage by an endless cable running at a speed of 50 ft. per second. The cage moves at the rate of 1.64 ft. per second. If the cable should break the cage simply descends on the track by its own weight and under brakes.

SOUTHERN industrial progress still continues very notable, the *Manufacturers' Record* of Baltimore publishing the following remarkable comparative list of new enterprises started in the first half of this year and last; we hope it is reliable:

	For six months of 1887.	1886.
	Number.	Number.
Iron furnace companies	20	7
Machine shops and foundries	53	40
Agricultural implement factories	11	7
Flour mills	68	48
Cotton mills	44	8
Furniture factories	33	18
Gas works	24	15
Water works	46	15
Carriage and wagon factories	20	11
Electric light companies	33	17
Mining enterprises	313	70
Lumber mills	361	248
Ice factories	55	30
Canning factories	49	8
Stove foundries	2	3
Brick works	116	36
Miscellaneous iron works, rolling mills, pipe works	47	8
Cotton compressors	26	7
Natural gas companies	30	16
Miscellaneous enterprises not included in foregoing	475	198
Total	1,855	812

A NEW electric exploder for use in mines has lately been introduced in England by G. E. SMITH; it is described as follows:

This little dynamo weighs 5½ lbs., and packs in a case about 7 in. cube. The baseboard measures 6 in. by 5 in. The hand-wheel is 6 in. diameter. The machine is wound with wire on what is known as the shunt principle; the field magnets to a resistance of 4½ ohms, or thereabouts. The armature is of the H class, double wound with wire It is capable of giving a current of about eight volts and two amperes, if turned quickly, and would the light a four candle-power incandescent lamp, or give a light equal to two at least of the best and brightest safety lamps. It explodes fuses in a remarkable manner, a couple of turns of the hand-wheel being as a rule sufficient for Abel's fuse.

There is a peculiarity in the connection, which renders the machine useful for other purposes by a slight alteration in the position of one of the brushes or collectors. Unlike other forms of electric exploders, it has no permanent magnets to require magnetizing; and, unlike the friction exploder, it is unaffected by damp atmosphere. The price is also below that of the other machine (price about 40 s.) It is much lighter in weight to carry about the mine. The incandescent lamp could be attached to examine the roof or anything near when the shot had been fired, being, as all know, a perfectly safe light even in gas. It will also fire the platinum fuze, which the other exploders will not, if made for Abel's fuse. As this particular machine was not made for exploding fuses only, it has the keys and safety plug separate, but of course one or both of these arrangements could be attached to the baseboard where necessary.

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EDITORS.
GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

THE address of Mr. A. ALLAIN, a draftsman, supposed to be residing in Newark and engaged in New York, is wanted at this office.

FIRST the blade; then the ear, afterwards the full corn in the ear. The Philadelphia Bridge Works have just shipped a 110-ft. span standard American railway bridge to China, which we believe is the first of equal magnitude to be sent to China from any country. The largest span in Japan is also of American construction.

WE have received from a correspondent who signs himself $\frac{dx}{dy}$ a letter as to the standing and salaries of engineers called out by an editorial note in our last week's ENGINEERING NEWS, which he states was in reference to "the pay of civil engineers" and contending that their pay is not what it should be.

As we wrote no article on the pay of engineers, and as we cordially agree with our correspondent's position, it appears unnecessary to reproduce the letter. What we said was, in brief, that a young man but a year out of college who was offered "a position of some responsibility" and $50 per month besides, had no reason to complain or feel insulted, but rather to rejoice; perhaps more reason to rejoice than if he had obtained some other position at $75 or $100 per month, as men of that age frequently do. And we may add further, that in proportion as the engineering profession as a whole becomes a more attractive and desirable one, the pay of young men entering it must tend to grow lower, for the reason that more young men will wish to enter it, and the competition among them will be sharper. It is hard to preach what none of us have practiced, but it would be better for all young men, and they would get along faster in the end, if they would wholly subordinate the question of pay to that of getting a good and varied experience for the first five or six years of their practice, while they are laying the foundations of sound engineering knowledge. It is fortunate for young men that there is legitimate room and necessity in engineering work for a large proportion of comparatively young and inexperienced engineers. It makes entrance into the profession far easier than into medicine or law, or perhaps even divinity. But it is not always remembered that this very fact tends to keep down the pay of the older engineers by increasing the pressure of fairly well qualified men for their positions, and it is they rather than the younger men who have the chief cause to complain at the "market rates." The subject is too large a one, however, to discuss in an editorial note.

THE Tehuantepec Ship Railway project is still active. Last Wednesday a preliminary meeting was held in Pittsburg, in which Col. JAS. ANDREWS, WM. SHAW, Vice Prest. Penna. Co., ex-Secretary of the Treasury WINDOM, CHAS. J. CLARK and others took part. It was determined to reorganize at once in Jersey City, and merge in the new company all the rights and privileges of the Eads Concessions. They will organize a ship-railway company and put its bonds and stock upon the American market first, with the hope that the enterprise may be made distinctively American. The projectors are in earnest and very confident of success, and we would much like to see this colossal engineering experiment of thorough Yankee origin and boldness of conception, put to the test of practice.

FRENCH despatches show that at last the people of France are losing faith in Mr. DE LESSEPS and his Panama canal. Despite extraordinary efforts, in the direction of rose-colored press accounts, huge posters, etc., only about two-thirds of the bonds are subscribed for. This will give the enterprise about $28,000,000, but as $18,500,000 is wanted annually for administration and interest, the balance left for work on the canal is small.

THE Baltimore & Ohio deal, which for several months has been a chief topic of interest in railroad and financial circles and has excited such general interest in all quarters, was last week officially declared a failure. In a letter to the Philadelphia *Record* Mr. GARRET said:

"The syndicate which was to acquire a large block of the B. & O. stock did not comply with their engagements, and all arrangements or negotiations with them are now absolutely at an end."

This and other incidents seem to indicate that the meteoric career of the Cincinnati, Hamilton & Dayton syndicate is about over. As we predicted the Pennsylvania has brought suit to break the lease by which the Vandalia line is held, which, if successful, will make IVES recent lease of the Terra Haute & Indianapolis a very poor investment.

For the last few months the projected B. & O. extensions have been pretty much at a stand-still, as was but natural under the uncertain condition of affairs. The final decision in the matter of the proposed Arthur Kill bridge will be given by the Court within a few days; and should that be favorable to the B. & O., as in all reason it must be, we may expect that no time will be lost in pushing the New York extension. But all the more because of its connections at New York, the B. & O. will be blind not to see that it has a remarkable opportunity open to it on its southern border by reason of its geographical position. The present and prospective development of the railway system of the South is a marked feature of the day and it goes without saying that the flow of traffic between these systems and those of the North is to have a great and rapid increase. The Baltimore & Ohio lies on the southern edge of the railway belt of the North. The country lying just below it is to a large extent undeveloped by railways. It has already made the preliminary moves toward opening up the almost untouched State of West Virginia, and the Southern railway systems are many of them in a condition where control would be easy to obtain. From its present southern terminus at Lexington, Va., an extension of but a few miles will connect it with the Norfolk & Western, and thus, when the connection by the Clinch Valley line is completed, with the Louisville & Nashville system. Near the same point is to be the terminus of the Tennessee Midland and Virginia Western road, a direct line from Memphis and central Tennessee to the exporting cities of the coast. Another possible piece of generalship would be the control of a direct line to Atlanta, for which plenty of projects are in the air and some have a good deal of financial backing.

Acquiring a New York terminus will be likely to have a material effect on the B. & O. policy, for in these days of rapid developement, he who stands still is left behind.

THE Massachusetts Railroad Commission has issued a circular which implies that a very thorough supervision over the bridges of the State is to be maintained hereafter. A strain sheet and complete drawings, with answers to 17 distinct questions as to location, design, etc., are to be made for each structure, all on sheets of uniform size 20 × 40 in. with a 2 in. margin on the left side. The scales for drawings are to be ½ in. per ft., with ½ to ¾ in. per ft. for details; the complete floor system to be clearly shown. There is also to be sent a copy of the specifications, or of the tests made, if built without specifications; of the frequency of inspections and results, and a report by a competent and experienced engineer on the bridge, covering every detail of the structure, its masonry and approaches.

An immense amount of work is involved in carrying out these instructions, but it is divided among many hands, and it will be work well bestowed. We have no doubt that the engineer selected by the Board, Prof. GEO. F. SWAIN, will see to it that the plans sent in are properly scrutinized, and that no more eccentricities of practice like the Bussey bridge hangers will remain in the State undetected; at least within the city limits of Boston. Unfortunately, a correct drawing does not necessarily imply a correct bridge, since sad discrepancies turn up, nor does a drawing show quality of material or workmanship, but much will no doubt be accomplished.

A correspondent of the Cincinnati *Commercial* tests the credulity of the public (and judging by the extent to which it has been copied, very successfully) by the following absurd allegations, on the strength of which he urges the calling of an extra session of Congress to take some action in the matter! He says:

Boring for natural gas should be prohibited by stringent laws. The good people of Ohio and Indiana while trying to develop the gas magazines, do not take time to consider that they are toying with a force that may destroy this country and themselves. The danger that impends is well known to scientists(?)

Two hundred years ago in China there was just such a craze about natural gas as we have in this country to-day. Gas wells were sunk with as much vim and vigor as the Celestials were capable of; but owing to a gas explosion that killed several millions of people and tore up and destroyed a large district of country, leaving a large inland sea, known on the maps as Lake Foo Chang, the boring of any more gas wells was then and there prohibited by law.

It seems, according to the Chinese history, that many large and heavy pressure gas wells were struck, and in some districts wells were sunk quite near to each other. Gas was lighted as soon as struck, as is done in this country.

It is stated that one well, with its unusual pressure, by induction or back draft, pulled down into the earth the burning gas of a smaller well, resulting in a dreadful explosion of a large district and destroying the inhabitants thereof. Lake Foo Chang rests on this district. The same catastrophe is imminent in this country unless the laws restrict further developments in boring so many wells. Should a similar explosion occur there will be such an upheaval as will dwarf the most terrible earthquakes ever known. The country along the gas belt from Toledo through Ohio, Indiana and Kentucky, will be ripped up to the depth of 1,200 to 1,500 ft

and flopped over like a pancake, leaving a chasm though which the waters of Lake Erie will come howling down, filling the Ohio and Mississippi valleys, and blotting them out forever. Some prompt action should be taken at once to prevent this catastrophe.

Mr. T. W. JONES, the author of an Indian book of "Rules and Tables" for trackmen, which we noticed in our issue of March 19, writes us from Jamalpur, India, to state that his work being intended primarily for India, where the 4 ft. 8½ in. gauge is not in use, it did not seem necessary to give it, but that he has included that gauge in a later edition. He also states that in the lists of a number of American and English publishers he cannot find "the names of any books suitable for English or Indian inspectors of permanent way," and asks for further information. The best we can give is that in PAUSON'S "Track," published by this journal, and in the last edition of Trautwine's "Pocket Book" (the last edition having been considerably improved in this respect) he will find the best available information as to American practice. His closing statement must have occurred to a good many other people that "it is very difficult to determine whether some of the information contained in Pocket Books is derived from English or American sources, when one finds the same thing in Molesworth, Hurst, Hamilton, Spon, Nystrom and others." There has been an inexcusable mixture of English and American practice in some of these books. Fortunately, however, most of those mentioned, although they have been very useful in their day, have now passed out of date.

A Montreal paper gives a long description of another of those delusive experiments of putting out fires in cars in case of accident in a kind of Babcock extinguisher fashion by carbonic acid gas. If the fire would stay in one place this would be all very well, but no process for extinguishing fire even by water can be a satisfactory protection, for the reason that the same cause which creates the necessity for extinguishing the fire is also extremely likely to scatter it. It is possible to extinguish the flame of a coal fire instantly by plunging it in carbonic acid gas, but it is not possible to dissipate its heat instantly and hence if the coals are at all scattered they will start a fire anew despite the carbonic acid gas. There is no sure protection but to dispense with fires on the cars altogether, which is fortunately the cheapest method as well.

We find in one of the papers before the Institution of Civil Engineers the singular statement that "The transmission of power by steam was tried at New York, but it was abandoned, as the steam condensed in the underground pipes, and the water was ejected." As this system is now in very successful and extensive use the error is hardly a pardonable one although its origin can readily be traced to a confusion between the company which failed, owing to defects in its plant, and the one which succeeded. The same paper gives the following table (which we hope is more correct than the above) showing the relative cost of transmission of 100 H.P. to given distances, by four different systems.

Systems Employed.	330 Feet.	1,640 Feet.	3,280 Feet.	16,400 Feet.	32,810 Feet.	65,620 Feet.	Motor.
	d.	d.	d.	d.	d.	d.	
Electricity	1·80	1·84	1·94	2·27	2·84	4·61	Steam.
Water-Pressure	2·27	2·36	2·61	4·09	5·79	9·57	
Compressed air	3·17	3·23	3·33	4·05	5·35	6·39	
Ropes	1·26	1·49	1·56	2·88	4·29	12·66	
Electricity	0·46	0·48	0·53	0·62	0·68	1·15	Hydra'l.
Water-Pressure	0·46	0·55	0·62	1·33	2·23	3·54	
Compressed air	0·72	0·80	0·84	1·21	1·86	3·36	
Ropes	0·28	0·27	0·30	0·80	1·43	3·39	

THE Franklin Institute is proposing to do a very good thing, through its publication committee, in preparing an Index of Authors and Subject Matter of the first 110 volumes of its publications, from 1826 to 1880. The completion of this valuable work will depend greatly upon the amount of subscriptions received at $5 each to cover the cost. We earnestly trust that the public will respond liberally to this project, as a vast amount of interesting and valuable history, connected with our advance in mechanical, scientific, and engineering knowledge in the last fifty years, lies hidden and practically inaccessible in these volumes, all for the want of just such an index. In mechanics alone, it should be remembered that the Franklin Institute was practically the parent of our present patent system, and its volumes are the depositories and only record of many curious, interesting and historically valuable inventions.

The Chagres Dam.

The first intimation of a definite plan for this mammoth work which has come to us is that given on another page, and it cannot but be read by engineers everywhere with very great interest. It is in a word to dig away from 10 to 40 ft. of gravel and soil which lies above the bed rock of the Chagres valley, and then make an enormous embankment of broken stone spoil from the Emperador and other convenient cuts, a quarter of a mile wide on the base, more than a mile long, 164 ft. high above the bed of the stream, and with 4 to 1 slopes on each side. The exterior faces are to be rip-rapped with heavier stone, and a clayey earth filling to be made on the inside of the rock dam, by the aid of which it is expected that the dam will seal itself. The outflow is to be through a tunnel in the solid rock. The danger of insufficient reservoir capacity would seem to be a remote one, if the figures given are at all trustworthy. The tunnel discharge through rock may of course be made perfectly safe and secure. The whole question resolves itself into that of the permanent stability of a dam so constructed, which would contain at a rough estimate some 15,000,000 cu. yds. of material. No overflow over the dam, nor gates through it, have to be provided for. It is of no importance if the reservoir fills up completely below the level of the outlet tunnel, but rather very desirable that it should. During most of the year the level of the water will be far below the maximum. Loss by seepage is of no importance, however great, unless it endangers the stability of the work.

These are great advantages, yet whether such a rough and ready plan for so vast a work has any elements of the feasible about it, will be a matter of dispute among engineers. Theoretically, it ought to be practicable, for it is often used with entire success on a small scale, but it will at least be a grand feat of engineering if so simple a plan does succeed and it must be admitted to be a rather hazardous experiment which few engineers would like to venture on, considering the enormous pressures to be dealt with.

Yet if the pressures are enormous, the mass of material through which the pressure must drive the water is also enormous, as also the distance through which the water must pass before it can escape to do any damage. We may reject at once the over-confident suggestion of Lieut. REYNOLDS that it would not even be necessary to found the embankment on bed rock, but let it rest directly on the natural surface. Under such circumstances, water channels would be sure to establish themselves under the enormous head of 150 or more feet of water, which would rapidly enlarge, and soon reach a volume of discharge which would destroy the work, and that would mean practically the destruction of the entire canal. The superincumbent rock would be in part sustained by the hydraulic pressure, and in part (the greater part) would sustain itself by arching above the gap, until the substratum would be so washed away that it would be impossible to stop the flow. When filled to a level of 40 m., 10 m. below the crest, the reservoir is estimated to contain 316,000,000,000 gallons, covering an area of over 54 sq. miles to an average depth of nearly 30 ft. It would not be well to "monkey with that buzz-saw." If such a mass of water once broke forth, it would hardly leave a trace of where there had once been a canal in either direction. Its enormous volume will be seen by remembering that it is about ten times the volume of the proposed Quaker Bridge dam storage (32,000,000,000 galls.) which in turn is over four times the storage of the Central Park storage reservoir (675,000,000 galls.) and this is among the very largest of such works.

But the area of the reservoir makes little difference. It is the head which counts, and in this respect the Chagres dam would be far below the Quaker Bridge. Therefore, keeping in view the mass of the proposed dam and the peculiar conditions under which it would be constructed, it appears reasonable that the contemplated plan may be the best, and that it may be carried through successfully at a cost which would be no very large percentage of the total cost of the canal. The vast excavations near at hand afford abundant material for its construction at cost of haul only, while the scarcity of skilled labor and the magnitude of the work forbid the use of masonry. It is not suggested in the outline of the plan, but there being abundance of water and of earth at hand it would seem entirely feasible to fill in the interstices of the rock almost solid with sand and earth as the work progressed by the aid of water, nor would it be necessary or even expedient to excavate down to bed rock over the entire width of over a quarter of a mile under the base of the dam. A succession of very wide trenches would suffice. The enormous magnitude of the work and the serious consequences of any great defect in any part of it might well make any engineer tremble at assuming responsibility for its safety, but granting reasonable care and skill and plenty of money we must confess we cannot see why it may not be successfully carried through at a very reasonable cost per cubic yard. There still remains the cost of the channel changes below, which may amount up to an unkown sum, but granting the stability of the dam there is only a constant and moderate flow to be provided for in these channels.

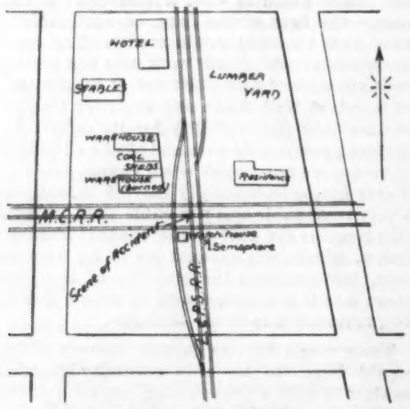
There would be one further danger which would have to be very carefully guarded against in such a construction, choking of the outflow tunnel. Let this once be choked, and water begin to run over the crest, and the whole structure would almost certainly go out in very short order. The current through the tunnel would be very swift, and it would take a large tree to resist it across a clear span of 20 ft., but unfortunately, the choking would take place, presumably, while the tunnel was not running full, and once started, an almost immovable dam might form very quickly. There would be one precaution which we do not find suggested, which would be imperatively necessary, to enlarge the section beyond the entrance, so that choking, if it occurred, might be only at the mouth. As it would then take 208 hours (or nearly 9 days) for the greatest recorded flood to fill the reservoir to within 10 metres of the crest, it would be easily possible for a level-

headed man to clear the mouth of the tunnel by dynamite, and a still better precaution would be to have a permanent boom in the reservoir to catch floating timber which might make trouble; but without some pretty careful precautions in this direction there would always be a danger, and a great one.

Grade Crossing Collisions.

From one point of view at least, it is almost a pity that in the crossing collision at St. Thomas, Ont., which we noted last week, there could not have been 100 killed and 12 badly injured instead of 12 killed and 100 injured. The question of eliminating grade crossings would then have received the attention which it deserves from the entire fraternity of railway officials; whereas now, although this is by far the most serious accident since the Bussey bridge, and will be among the three or four notable ones of the year, it is not likely that it will have any very lasting influence, outside of the roads more immediately concerned, one of which at least is already pursuing the policy of protecting its crossings "as fast as possible." As a consequence fatal crossing disasters will continue to occur at frequent intervals for some time yet in the future, which would not have occurred if the public could have been once thoroughly stirred up on the subject, and skeptical or indifferent railway officials compelled to think about the matter, as they were last year about the car-heating question. It follows that the aggregate fatalities are likely to be far greater than if they could all have been bunched in one great disaster which would have led to a thorough overhauling of the whole question.

The St. Thomas catastrophe is a striking illustration of the fact that under no conditions whatever can a crossing be made safe if reliance be placed merely on signals and stops. Both roads, as will appear from the accompanying sketch, are on a dead straight line



The St. Thomas Collision.

and practically level grade. The crossing is in the heart of a large town, where speed must be slow, and immediately adjacent to the principal station of both lines. All signals were duly given and the accident occurred in broad day light on a clear day. Yet a passenger train of moderate length ran right into the middle of a passing oil train and a destructive fire immediately ensued.

The usual excuse was given that "the air brakes failed to work," and it was immediately announced that an investigation would be held "in regard to the cause of the accident, and to discover the one on whose shoulders the blame should rest." The blame was finally thrown on the trainmen for not testing their brakes when starting out, as the rules required. But while this throwing off of blame onto the shoulders of careless employés may be technically defensible, yet the blame in all such accidents, in A. D. 1887, rests primarily and heavily on the shoulders of the higher managing officers, if they have neglected to provide themselves with what has been known for years to be the only real protection at such points against such inevitable forgetfulness, effective inter-locking apparatus with connected derailing switches which make it CERTAIN that if one train attempts to run past signals into another train, from whatever cause, it will run into a ditch instead. Were our law makers as wise as they should be, they would make it a criminal act for any road to neglect this precaution after a certain near date.

We say this because of all disasters of common occurrence those at grade crossings are perhaps the least excusable, since the danger does not exist because it would cost money to avoid it, as with many others, but in spite of the fact that a great deal of money would be saved by saving the danger as well. The American public has become so habituated to grade crossings that they have come to look on them as almost a necessary evil, and it is hard to awaken any decided sentiment against them, but engineers and railroad men at least should by this time have thoroughly learned the lesson (1) that nothing except an over-crossing or protection by interlocking and derailing switches gives even reasonable safety, and (2) that one or the other of these is far cheaper as well as better than the ordinary grade-crossing with stops. No better illustration of either of these facts could be had than the St. Thomas disaster.

We are not of those who believe that railways are bound to eliminate all removable risk to life at whatever cost. There is a great deal of loose and silly talk to this effect, but the bald fact is, that the community cannot afford more than moderate expenditures for such purposes. In a thousand ways, of which perhaps the inflammable nature of our city buildings and our city sanitary arrangements are the most conspicuous and the least defensible, the great public recognizes and acts on this principle, in its own individual affairs, and what it is not willing to do for itself, it has no right to demand of the railways, but it does excite a certain natural regret and indignation to see antiquated methods of throwing away money and life together persisted in all over the country, year after year, in the face of well known more excellent ways, even the first cost of which is trifling.

Let us briefly run over the figures. A complete grade crossing interlocking apparatus costs from $3,000 to $5,000, averaging perhaps $3,500, including 4 home signals, 4 distant signals, 4 derailing switches, electric locking (to prevent careless reversal of signals after one train has entered the block), erection and building, complete. No extra employés are needed. On the other hand, paying no attention to the extravagant estimates of a dollar or more which are sometimes made, a stop cannot well cost less than 25 or more than 60 cents. At 40 cents it amounts to $146 per train per year or for ten trains per day each way to $5,840 per year. If the crossing stops are cutting off a car or two from the train, as very many of them are, this loss must be multiplied several fold, but even if we consider the direct loss only, more is lost *per year* on most roads than the total cost of protecting the crossing. If an over-crossing is practicable, that is of course better yet, but the difference either in safety or economy between an interlocked grade crossing and an over-crossing is not great enough to make the choice particularly important. All that can be said is that there is no real excuse for not using one or the other in all cases, and that if there be a subject on which mandatory legislation is justifiable and expedient, as we said before, it is this. The present laws on the subject are merely permissive, and even permissive laws only exist in eight or nine States. Moreover, the permissive laws are without any exception open to serious objection in their wording, for the reason that they do not provide any other mode than mutual agreement between the two roads concerned for the erection of interlocking plant at their crossings. Were such plant a mere luxury or a mere ordinary betterment this might be proper enough, but as it is both a great safeguard and a great economy it is an unfortunate error to practically prohibit its prompt introduction instead of compelling it, as would be the wiser way. To reap the full advantage of eliminating crossing stops most roads have to protect perhaps a dozen or more crossings at once belonging to as many different roads. As the law now reads in every State the manager who wishes to do this has the interesting task on his hands of not only persuading a dozen different managements that it would be desirable to erect such plant, but also to persuade them to assent to a particular mode of dividing the cost. It is small wonder that there should be no great eagerness shown in entering on such negotiations. We may rather wonder that so many roads have done so much notwithstanding. Thus, the Michigan Central road, on which this disaster occurred, have already definitely adopted the policy of interlocking crossings. They have four or five already interlocked, and as many more contracted for, to go in the present year, but that it has not acted fast enough this accident shows, even if, as may be the case, the Canadian law does not yet give the right to dispense with crossing stops by interlocking. The merits of that method are now, and have been for some ten years, so well established that permissive laws could unquestionably have been obtained at any time if asked for.

It cannot be many years before unprotected grade crossings will be things of the past throughout the country, and it cannot come about too soon, either for the interest of the stock-holders or the interest of the public. Except for the unfortunate fact that the loss is a concealed one, a kind of ooze from every pore, which does not directly appear in any accounts or reports, it would have been stopped long since, had it been but half as great as it is.

CORRESPONDENCE.

Traction Engines.

COLUMBUS, O., July 21, 1887.

EDITOR ENGINEERING NEWS:

Have you knowledge of parties who manufacture or sell a good strong traction engine that can be used for heavy plowing? If so, please give me their address, or notify them to communicate with me. I have used a 10-ton Aveling & Porter steam roller for plowing, and with success, except that it is too cumbersome and also lacks proper strength in some parts. I know a machine can be made to fill the bill and wish to know whether there is one *made*. You will remember me as a subscriber for several years. Yours truly, N. B. ABBOTT.

[Traction engines which shall be certainly efficient and economical for a given service are a long felt want but are rather a dangerous thing to venture on in a recommendatory way. From certain difficult requirements which must be met in their design, they have failed to be so successful as to multiply very fast. They are put on the market in this country by several firms, the Harrisburgh Car Works for one. One which showed good results in a test which we witnessed was made by WOOD,

TABER & MORSE, Eaton, N. Y. In England JOHN FOWLER & Co. and AVELING & PORTER make them a specialty. We hesitate to recommend any special makers. Perhaps some of our readers with experience in such machines can give our correspondent the information asked for from their own observation or experience. —ED. ENG. NEWS].

Roman or Natural vs. Portland or Artificial Cement.

NEW YORK, July 6, 1887.

EDITOR ENGINEERING NEWS:

The relative merits of these two classes of cement has of late provoked much discussion, useful or even permissable only when a valuable conclusion is possible. With the *present* knowledge of the artificial or Portland cement, no conclusion is possible, for, as a product it has been known but for a short period, about 30 years, which is far too limited an experience for testing the durability of masonry designed upon a large scale for permanent public use, such as the Brooklyn Bridge, the New Aqueduct, the proposed Quaker Dam and other projected enterprises. It is less than a generation since attempts were made in England to devise a substitute for the natural or Roman cement in use, and made from the argillo-calcareous nodules of septaria found in the Isle of Sheppey, or the similar material found in the Isle of Wight, from which the medius cement, a similar natural product, was obtained. At Harwick, and in Yorkshire in England, and also on the Continent similar material was found, but the supply was rather limited and under circumstances that made its manufacture costly, and so an incentive existed in these countries to find an artificial substitute. After many attempts and failures a fair degree of success was reached, some 50 years, ago in the product since known as Portland cement, made and used largely abroad, and still imported into this country to a considerable extent, although REID'S work on its manufacture, and a standard authority, mentions several instances of failure when used for concrete upon important work in Europe, and in this country. Its failures are certainly in proportion to its use, fully as numerous as with our common natural American cement.

In this country the manufacture of Portland cement has had a very limited and precarious position, for although the duty on the imported article was intended to foster its home production, yet the system of under-valuation avoided largely the protection supposed to exist, while prejudice in favor of a foreign article, particularly an "English" foreign article aided in keeping the manufacture in this country in a feeble condition. This may be said however, as to the manufacture of Portland cement in this country, it can be and now is produced here in every way fully the equal of any imported—probably better, for it is not the very best grade that is usually sent here. On the other hand our own manufacture is struggling for recognition, and care is taken to produce a good article.

Aside from the reasons given for the limited production of Portland or artificial cement in this country, however, there exists another and a much more serious obstacle, and this brings us back again to a consideration of the entire uselessness, in this country, of any discussion of the merits of the two classes of cements, the Roman or natural, or the Portland or artificial. This is simply that in the United States we have no use whatsoever for the artificial article. Experience with it has been too limited to guarantee permanency, if not obliged to place it on trial, for that is about all that as yet can be said of it. It promises fairly, a higher grade of manufacture is demanded for it, paid for and consequently obtained, a higher tensile strength, perhaps premature but not necessarily conducive of permanency, possibly like other things in nature only indicative of shorter matured excellence, and thereafter rapid deterioration, and so far as ascertained this only for the first year or so; much of it swells and some of it shrinks; some have one thing added and some another to give it color or quickness. With all the faults of the natural cement and some peculiarly its own, without a record covering any comparative length of time, and that record but experimental in part and spotted with failures clear through, it cannot be as yet relied upon in place of natural cement, for the manufacture of which we have in this country vast deposits of material available for just as fine an article as our people will pay for.

Even in this new country we have in the locks of the Erie canal, at Lockport, samples of work done with our natural rock (and intact) as long ago as the first invention of the Portland article, while samples two thousand years old exist to-day in the remains of Roman aqueducts where the cement has outlasted the other building material. "Old Carthage" had an aqueduct with arches 100 ft. high, built with hydraulic cement, undoubtedly the natural product, and among the ruins may be found pieces 100 ft. long fallen from the top and yet so strongly cemented together that in the fall the cement held the mass together. At Nimes, in France, still remains, nearly perfect, an aqueduct 873 ft. long, 188 ft. high, built 1,600 years ago, still retaining on the walls of the canal crossing its three tiers of arches, "a thick coating of Roman cement." Lime of Tiel, classed not as a cement but as a hydraulic lime, incapable of standing immediate immersion, not able to show a tensile strain of 10 lbs. in 24 hours, has been put into sea walls for 50 years, and thousands of tons have been used—a thoroughly natural product. Who ever heard of its failure?

Compare this with REID'S record of the use of Portland or artificial product for the same uses. No, the whole discussion in this country is a useless one. We have a supply of the best, the most reliable and the cheapest material for hydraulic cement in our natural rock. We are not under the necessity of finding an imitation; 75 to 80 per cent. of the cost of the imitation article, or say from $1.25 to $1.50 per barrel, will, if devoted to the production of a natural cement, produce an article that no artificial or imitation article can equal. Every dollar for plant to produce or for product beyond the cost of an equal quantity of the natural article spent, is waste. We lead rather than follow the rest of the world in the originality and vastness of our engineering enterprises. We now have engineers educated in this country thoroughly competent—and plenty of them—free from prejudice and independent. Let us look at the question of the merits of the two classes of cement in the light of experience, and our own necessities and resources. Experience is given in the records of 2,000 years past. Our necessities are for the best article as proven; and our resources happily render any discussion unnecessary. Yours truly, J. S.

Concerning the "Unsafe Floor-Beam."

NEW YORK, July 26, 1887.

EDITOR ENGINEERING NEWS:

The publication of my report upon the floor-beam submitted to me by Mr. BUDDINGTON compels me to make the following explanation.

When I wrote this report I assumed that the work was under *Mr. Buddington's charge* and that he desired my opinion for *his own private guidance*. He said nothing about its being already constructed or as to its location.

Had I been aware that he held no official connection with the work, I should have refused to give him an opinion upon it.

Work already built must be considered from an entirely different view from work to be constructed. The latter must be considered from a more rigid view as to the allowed strains and maxima possible from even questionable theories. They must be built for future possibilities and all errors should be towards excess of strength.

We have, however, no right to pronounce as *unsafe* or *dangerous*, structures which do not fulfill the requirements made for new work.

An excess of the usually allowed strains now adopted would not necessarily be dangerous, and in such cases the expert must use great caution in drawing the line between what is absolutely dangerous, what is subject to special care and watching and what is solely undesirable, due to doubts as to the action of the parts or as to the theories of the strains.

I regret exceedingly that Mr. BUDDINGTON should have placed me in a false position by seeking and using my report upon this work in such a manner.

Yours truly, THEODORE COOPER.

The New Method of Dimensioning.

ANN ARBOR, Mich., July 12, 1887

EDITOR ENGINEERING NEWS:

Referring to the criticism, in your issue of July of my recent articles on the above subject, I would say that I cannot agree to the exception Mr. JAMES L. GREENLEAF makes to one conclusion of mine. In your issue of May 21, 1887, p. 330, I said:—

"Without assuming anything more than three facts agreed on by practical engineers, formula *A* has been deduced; and the fact that it takes the same form as formulæ deduced from the experiments of WÖHLER and SPANGENBURG simply adds weight to its value and shows these experiments to be in harmony with general experience."

Mr. GREENLEAF'S belief is that this additional weight is unwarranted, for, he argues, the line of reasoning adopted by me is practically the same as that employed by LAUNHARDT. It is with this argument of Mr. GREENLEAF that I cannot agree.

The process adopted by LAUNHARDT in the demonstration of his formula* consists of (1) theorising on WÖHLER'S law, (2) applying what appears to be, to a practical engineer, a mathematical dodge to obtain a definite result, and (3) an appeal to a few experiments of WÖHLER on Krupp's untempered cast spring steel.

My demonstration of formula (*A*) does not necessitate any knowledge of WÖHLER'S law, as it substitutes therefor a law well known to all practical engineers; does not necessitate any clever dodge in mathematics; nor does it depend upon a few selected experiments of an individual engineer upon a material foreign to the purpose.

With all due respect for LAUNHARDT'S formula, I believe that so long as the new method of dimensioning was based solely upon the experiments of two men, we could not expect the world to build its bridges on that method. It needed to be confirmed by the general experience of engineers before it could be generally adopted. One of my main objects in writing my articles was to show that the new method of dimensioning was in strict harmony with the experience of practical engineers, and indeed that their individual experience was gradually leading them to the adoption of the new method. With this object in view I abstained (and with this object abstain now) as much as possible, from the use of mathematical symbols and niceties, and indeed never thought of publishing the mathematical demonstration of formula (*A*) until a brother engineer wrote me that "WÖHLER'S experiments do not justify the superstructure that is being erected upon them," when I had to give the demonstration to show that the new method was entirely independent of the experiments of WÖHLER, though confirmed by them.

It was with this object in view that I took as an axiom, in the demonstration of formula (*A*), a law of change of the working stress *a*. When going through the demonstration (May 21, 1887, p. 330) I had in mind the following condition of things:

Cut a number of wrought-iron bars of equal length, each 1 sq. in. in sectional area, from a full sized tension member of a bridge. Let the bars be supported parallel to each other and in such a manner that each receives no strain from its own weight. Let one bar be strained with a dead load of 15,000 lbs., and another with a repeated load alternating between 5,000 lbs. and zero, with as much impact as usually subjected to in bridges. Now according to our assumptions each of these two bars will last indefinitely. If the two bars are now imagined welded or melted into one solid bar 2 sq. ins. area, and the same stresses allowed to act (the average working stress then becoming $\frac{15{,}000 + 5{,}000}{1 + 1} = 10{,}000$ lbs. per sq. in.), is there any reason for believing that the fatigue of the iron is greater than before? I think not. If now, in the line of our demonstration, two bars, each strained up to 5,000 lbs., be placed alongside the first bar, and all these be welded or melted together as before, is there any reason to believe that the allowable working stress should not be

$$\frac{15{,}000 + 2 \times 5{,}000}{1 + 2} = 8{,}333 \text{ lbs. per sq. in.?}$$ that

* As given by WEYRAUCH: Strength and Determination of the Dimensions of Structures of Iron and Steel, p. 11, J. Wiley & Sons.

the fatigue is greater in the latter case than in the former? I think not.

It was by repeating this process of reasoning that formula (*A*) was derived. I abstain from occupying your valuable space by giving theories which lead to these conclusions, as I believe they will be corroborated by your readers.

Before concluding I would like to make one correction. Mr. GREENLEAF gives formula (*A*) as

$$a = u\left(1 + \frac{t-u}{u}\,\frac{min.\ B}{max.\ B}\right).$$

Strictly speaking, this is LAUNHARDT'S formula, as Mr. GREENLEAF afterwards says: Formula (*A*) is

$$a = u\left(1 + 2\,\frac{min.\ B}{max.\ B}\right)$$

and I wish it to be so understood.

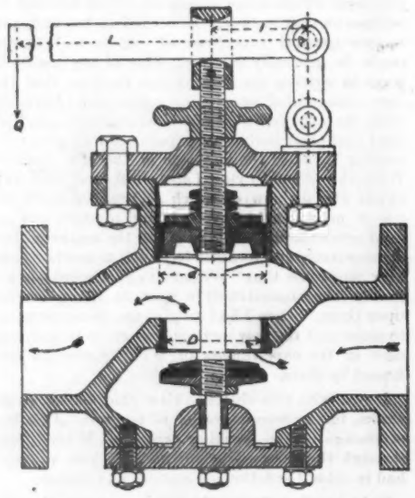
A. D. OTTEWELL.

Office of Chief Engineer of Water-Works,
MOSCOW, RUSSIA, June 18, 1887.

EDITOR ENGINEERING NEWS:

Let me express by means of your celebrated journal my frank thanks to all those City Engineers and City Councils of your country, who have shown their remarkable kindness by giving to me various information concerning the question of the adaptation of water supply to the extinguishing of fire in some American cities.

All this information has been of very much value to me, because it proved to me very clearly that in all those cities where water supply by the direct pressure system and water works with stand pipes have been carefully constructed and managed, these systems have been quite satisfactory for the purpose of fire extinguishing, and considerably more successful than extinguishing by means of steamers.



Automatic Stop Valve; Samara Water Works.

Not a very long time ago the direct pressure system of water supply was not even known, not only in Russia, but also all over Europe, although it was already adapted in many small towns of your country.

I think that it is my duty to inform all those gentlemen who have given to me their kind information that lately the direct pressure system of water supply was adopted by me in two Russian cities: in Tamboff and in Samara.

Speaking of the construction of the new water supply of Samara, I may make mention of two of its peculiarities:

1. Having in view to construct the works for as little expense as possible, the capacity of steam pumps was made just sufficiently large to pump 1,000 000 galls. in 24 hours under fire pressure.

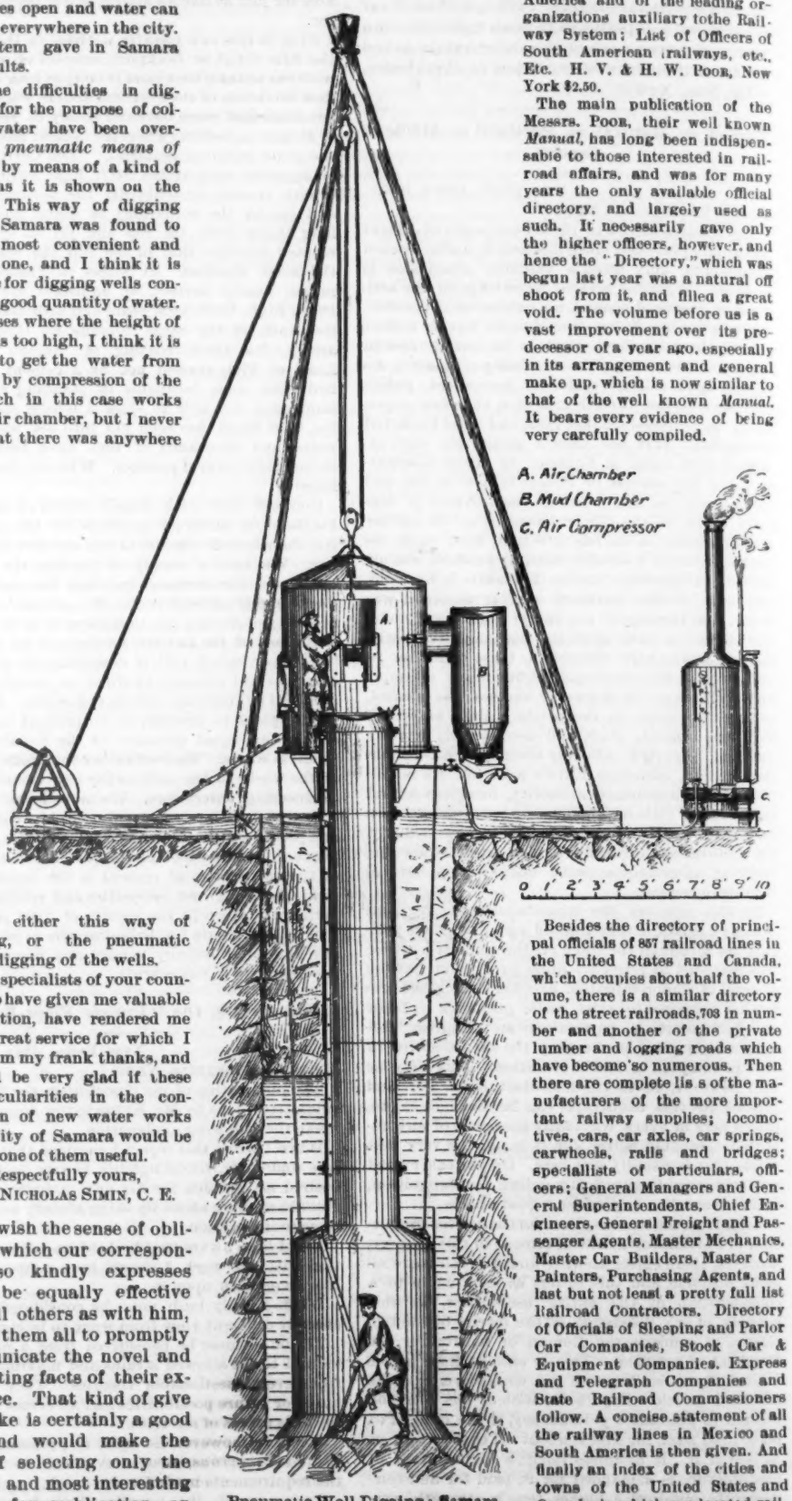
To be guaranteed that in case of fire the water supply would be able to deliver a sufficient quantity of water for each hydrant I arranged in my project to attain the following end: As soon as the pressure in mains (of direct pressure system) increases up to the fire pressure the supply of all street fountains and all houses ceases automatically by means of *automatic stop valves*, which are set on all these branches. From this moment all water pumped by steam pumps can be utilized only from fire hydrants. As soon as the fire is over and the pressure in the mains diminishes to the ordinary one, all automatic stop valves open and water can be gotten everywhere in the city. This system gave in Samara good results.

2. Some difficulties in digging wells for the purpose of collecting water have been overcome by *pneumatic means of digging*, by means of a kind of caisson, as it is shown on the tracing. This way of digging wells in Samara was found to be the most convenient and cheapest one, and I think it is advisable for digging wells containing a good quantity of water. In the cases where the height of suction is too high, I think it is possible to get the water from the well by compression of the air, which in this case works like an air chamber, but I never heard that there was anywhere adopted either this way of pumping, or the pneumatic way of digging of the wells.

Many specialists of your country, who have given me valuable information, have rendered me a very great service for which I give them my frank thanks, and I would be very glad if these two peculiarities in the construction of new water works of the City of Samara would be for any one of them useful.

Respectfully yours,
NICHOLAS SIMIN, C. E.

[We wish the sense of obligation which our correspondent so kindly expresses would be equally effective with all others as with him, to lead them all to promptly communicate the novel and interesting facts of their experience. That kind of give and take is certainly a good one, and would make the task of selecting only the newest and most interesting matter for publication an easier one to the puzzled editor. The letter is accompanied by a full-type written paper of 17 foolscap sheets on the details of the pneumatic work, which we have read with great interest, as we are sure our readers will, but we have space in this issue only for a part of the first page of the manuscript which, to avoid possible typographical errors we reproduce photographically, somewhat reduced.—ED. ENG. NEWS.]



Pneumatic Well Digging; Samara Water Works, Russia.

PUBLICATIONS RECEIVED.

Poor's Directory of Railway Officials for 1887. Containing lists of the Officers of all Railways in North America and of the leading organizations auxiliary tothe Railway System; List of Officers of South American railways, etc., Etc. H. V. & H. W. POOR, New York $2.50.

The main publication of the Messrs. POOR, their well known *Manual*, has long been indispensable to those interested in railroad affairs, and was for many years the only available official directory, and largely used as such. It necessarily gave only the higher officers, however, and hence the "Directory," which was begun last year was a natural off shoot from it, and filled a great void. The volume before us is a vast improvement over its predecessor of a year ago, especially in its arrangement and general make up, which is now similar to that of the well known *Manual*. It bears every evidence of being very carefully compiled.

Besides the directory of principal officials of 857 railroad lines in the United States and Canada, which occupies about half the volume, there is a similar directory of the street railroads, 703 in number and another of the private lumber and logging roads which have become so numerous. Then there are complete lists of the manufacturers of the more important railway supplies; locomotives, cars, car axles, car springs, carwheels, rails and bridges; specialists of particulars, officers; General Managers and General Superintendents, Chief Engineers, General Freight and Passenger Agents, Master Mechanics, Master Car Builders, Master Car Painters, Purchasing Agents, and last but not least a pretty full list Railroad Contractors. Directory of Officials of Sleeping and Parlor Car Companies, Stock Car & Equipment Companies, Express and Telegraph Companies and State Railroad Commissioners follow. A concise statement of all the railway lines in Mexico and South America is then given. And finally an index of the cities and towns of the United States and Canada in which are located railway general offices or repair shops, and an alphabetical index or directory of the railway officials named in the book.

This large and varied mass of information is all well arranged for convenient reference, and its great utility to those interested in railway affairs is very evident.

Special Intelligence Report on the Progress of the Work on the Panama Canal during the year 1885. By Lieut. W. W. KIMBALL, U. S. N., assisted by Naval Cadet W. L. CAPPS, U. S. N., Washington, Pub. Doc. pp. 38, and many plates.

Although this report refers to a now somewhat antiquated period in the progress of the canal it is in some respects still the most definite information available from an independent source, and as such we make some extracts from it on another page.

PERSONAL.

Mr. JOS. BROADDUS has been appointed Chief Engineer of the Chicago, Kansas & Arkansas R. R.

Mr. H. G. BURT has been appointed Chief Engineer, and Mr. J. M. WHITMAN, General Manager of the Chicago & Northwestern R. R.

Mr. ALBERT L. WEBSTER, has opened an office as Consulting Sanitary Engineer at 107 Drexel Building, corner Wall and Broad streets, New York.

Mr. WM. MCINTOSH, of Huron, Dak., Master Mechanic of that division of the Chicago & Northwestern R. R., has been appointed Master Mechanic of all the Northwestern lines west of Winona to the Missouri, with headquarters at Winona.

mining profitable. The development and the success of the famous Crimora mine is known to the metallurgical world. In 1885 he transferred his interest in the Crimora enterprise to CARNEGIE BROS. & Co. and went abroad for six months, upon his return and until his death he has been engaged in the development of not only the manganese ores, of Virgina, but also the manganese and Bessemer steel ores, of East Tennessee and Western North Carolina. Although still a very young man, his brilliant business abilities and attractive and generous personal qualities, had made him widely known, and universally liked; and his sudden death will be regretted by all who knew him.

Peru's Debt to be Removed.

It does seem after all that there is truth in the rumor, noted in a late issue, that W. R. GRACE & Co., of New York, together with certain English parties, have assumed the national debt of Peru in return for huge concessions. According to the agreement, consumated in London on May 26, between Sir H. W. TYLER, G. A. OLLARD, and MICHAEL P. GRACE and a committee of the Government bondholders and the Attorney-General of Peru, the following seems to be about the programme:—Peru desires to pay its debt, to conclude the construction and extension of the railway systems into its rich mining and agricultural centers, to encourage colonization by Europeans, and irrigate and develop valuable sections of its territory, but lacks the means necessary. The English bondholders enter therefore into the present agreement whereby the Peruvian Government assigns to the parties named, for a term of 66 years, all the railways belonging to it, with land, stations, rolling stock, etc., so that these English bondholders and their representatives may extend and maintain them.

By this agreement about 763 miles of railway are handed over to the bondholders. And in addition the latter will have for the same term of years the concession of all discovered and undiscovered guano; the right of the Peruvian Government to the 50 per cent. of the 1,000,000 tons of guano dealt with by the treaty of peace between Chili and Peru; a further concession of £120,000 a year from the customs duties of Mollendo and Payta, so long as £420,000 a year is not received for two consecutive years from the railway and guano concession; the perpetual right to work coal mines along the Chimbote and Huaraz Railway, with a reservation of 15 per cent. of net profit to the Government; the right to work cinnabar mines, and exclusively for 50 years in the Province of Huaucavelica, with a reservation of 15 per cent. of net profit to the government; the perpetual right to condemn and work 100 or more mines of gold, silver, copper, lead, or other minerals, subject to the ordinary tax of $30 a year per mine, payable to the Government; a concession of 1,800,000 hectares—say, 4,000,000 acres—of land, to be selected in five years; an additional 180 hectares—say, 400 acres—for every family introduced into Peru; rights of navigation in the rivers and lakes of Peru; the authority to establish a bank at Lima with the exclusive right to issue notes against one-third specie, and with 75 per cent. of the net profits after payment of 9 per cent. on the subscribed capital, the bank undertaking the administration of the internal debt of Peru, to be guaranteed by 8 per cent. of the customs dues of the port of Callao and some other revenues, and by 25 per cent. of the net profits of the bank after payment of 9 per cent. as interest on the subscribed capital; and certain privileges of immunity from taxation.

In return for these handsome concessions, the representatives of the bondholders undertake to make a specified extension of the railways within four years under heavy penalties; to examine and report to the Peruvian Government upon the coal and cinnebar mines; to pay the Government 20 per cent. of the net proceeds of railways, and 25 per cent. from guano, after the company has received £420,000 per annum; to deposit the bonds constituting the external debt of Peru—say £32,000,000—and cancel one-half that debt; to provide £350,000 capital for the bank to be established at Lima; to pay the Peruvian Government £400,000 in thirty months, and to transport free or at low rates the military and civil employés and materials and mails of Peru. It is expected that the other half of the external debt will be assumed by Chili as appertaining to the Province of Tarapaca, now part of Chili by right of conquest.

The bondholders committee think that the fulfilling of their obligations will require an outlay of £2,500,000, extending over a period of five years and taking into account the revenues to be meanwhile received. And to raise this amount they intend to issue debentures constituting a charge on the Peruvian concessions. In compliance with the agreement steps are already being taken for the incorporation of a Peruviau trust in the form of a limited liability company. It is intended to create a share capital of £15,000,000, and to allot the shares to the bondholders in exchange for the deposit of their bonds; the above share capital being taken to represent half of the Peruvian debt.

This agreement has yet to be ratified by the Peruvian Congress. But the committee think that there is not the slightest doubt but what this will be done at its meeting on July 25. Peru has paid no interest on its external debt since 1876; and beside the £32,000,000 of railway debt mentioned, has an internal debt of £11,000,000. Her natural resources are, however, capable of tremendous development in enterprising hands.

Сообщеніе (Инженера) Н.П.Зимина Ученому Отдѣлу Общества Распространенія Техническихъ Знаній. 20 декабря 1886 года.

О примѣненіи пневматическаго способа для устройства водосборныхъ, ключевыхъ колодцевъ Самарскаго городскаго хозяйственно-противопожарнаго водопровода.

Устройство колодцевъ для полученія подпочвенной-ключевой воды въ большихъ количествахъ очень часто представляетъ большія затрудненія и потому для всѣхъ интересующихся этимъ дѣломъ будетъ полезно познакомиться съ способомъ углубленія колодцевъ, примѣненнымъ въ 1886 году при постройкѣ Самарскаго городскаго водопровода, тѣмъ болѣе, что способъ этотъ представляетъ собою, какъ оказалось, очень полезное нововведеніе въ водопроводномъ дѣлѣ и, насколько мнѣ извѣстно, ранѣе нигдѣ не примѣнялся для устройства водосборныхъ колодцовъ.

Matter referred to on p. 80 (Russian type-writing).

Mr. F. A. HILL, of the firm of WAKEFIELD, & HILL, Consulting Engineers, of Sioux City, Iowa, is Engineer in charge of the Illinois Central extension from Cherokee to Onawa, Ia.

Mr. B. H. HULL, of the firm of Hull & Palmer, Civil and Hydraulic Engineers, Bridgeport Conn., has accepted his appointment as a member of the Board of Engineers from the Fourth Congressional District of Connecticut as Supervisor and Inspector of Dams and Reservoirs.

Mr. W. P. SHAW, Secretary of the Columbus, Hocking Valley & Toledo R. R., has been appointed Vice President and General Manager, to succeed Mr. WM. M. GREEN, resigned.

Mr. C. C. WHEELER, General Superintendent of the Chicago & Northwestern R. R., has resigned and will be succeeded by Mr. SHERBURN SANBORN, Assistant General Superintendent.

Mr. JAMES BREDIN WHITE died very suddenly at Butler, Pa., on July 7. He was born in Butler, Pa., in 1850, was educated under the personal tuition of his father, the Rev. WM. WHITE, D. D. In his twentieth year he entered the employ of Messrs. WHITE, OBB & Co., Pittsburg, continuing until the year 1880. In 1880 and 1881, he and the late M. C. DAVIS began the development of the manganese ores of the South and were the first firm (as J. B. WHITE & Co.) to make manganese

The relative immigration for this year and last has been:

	1886	1887	Inc. p.c.
For the past 12 months	328,895	483,116	46.9
" " 6	189,965	266,450	40.3
" " 1	44,643	65,384	46.5

The influx does not seem to be at an increasing rate any longer, at which there will be general rejoicing, but it is still great enough to indicate that times are to continue good for some time yet. An unpleasant feature however, is that the least desirable kind of emigrants, as notably from Italy, show the largest percentage of increase. Nothing is more notable than the change of sentiment which has taken place in this country in regard to emigration; a change which seems to be common to all classes. The feeling is almost universal that the burden is too great a one of assimilating such vast annual multitudes of ignorant and poverty stricken immigrants, and that the influx should be checked in some way. There is still plenty of room for the intelligent and industrious, but the difficulty of drawing a hard and fast line between the two classes is a great one. The simplest way of drawing it—undoubtedly crude, but probably on an average about right—would be a tax of $50 or $100 a head and the requirement of a previous declaration of intent to become a citizen.

to presume there are now 450,000,000 people in China. These figures represent nearly one-third of the population of the globe. It is a greater population than that of all Europe, and three times the number of people on the Western continent. Even at these enormous figures the average number of people to the square mile for the whole empire—85—is not so high as in some parts of the United States.

The Vogelsang Propeller.

The *Army and Navy Register* gives interesting details of the performance of the new Vogelsang propeller which is exciting a good deal of interest by reason of the remarkable account received here from Europe.

It is stated that when applied to a German torpedo boat, without any increase of power, the speed of the boat was increased from 21 knots to over 26 knots. There is trustworthy evidence that it has increased the speed of a number of launches and other small craft as much as 33⅓ per cent. The invention is about to be tried on one of the North German Lloyd steamers between Bremerhaven and London. The device was first brought out by the inventor at the Washington Navy Yard, and it seems strange that it was never officially reported upon here. Mr. Vogelsang's patent covers the following claims:

1. "A propeller consisting of a hub provided with two or more blades or wings grouped upon but one side and unequally distributed about said hub, but in which the distance between the blades is not uniform, and in which no two blades are diametrically opposite, substantially as and for the purpose specified.

2. "A propeller having its blades grouped upon one side of the hub or shaft only and in which no two blades are diametrically opposite, and in which the distance between the blades is not uniform and a non-propulsive counterbalance arranged upon the side of the hub or shaft opposite to that on which the blades are located substantially as and for the purpose specified.

3. "A propeller consisting of a boss or hub provided with two or more blades grouped upon one side only of the side hub, and in which no two blades of the group are arranged diametrically opposite, and a singe blade arranged opposite to the group of blades, but in which the distance between the blades is not uniform substantially as and for the purpose specified."

The inventor says of what he has been able to accomplish:

"With propellers in which there are a large number of equally distributed blades, the water is so greatly churned that it is difficult for the blades to obtain a solid hold in the fluid, and consequently the loss by slippage is very great. By arranging the blades as described, forming a more open space between them, they are enabled to take a firm hold upon the water, and the slip is much reduced, and this reduction is shown in an increase of speed with a given number of revolutions."

The theory of the device certainly seems plausible, and there should at least be no difficulty in determining by practical test whether or not it is efficient.

The Swedish Explosive "Bellit."

Bellit is a new explosive discovered by Mr: CARL LAMM, of the Rötebro Explosive Manufacturing Co,, near Stockholm, It is made of nitrate of ammonium and denitrobenzol; these when melted (at 80° or 90° Celsius) are mixed with saltpetre, forming a compound in which each molecule explodes. When pressed warm, bellit has a specific weight of 1.2 to 1.4, and one litre weighs 800 to 875 grammes.

When heated in an open vessel to 90° Celsius, bellit loses its consistency but does not begin to separate until 300° Celsius is reached: it then begins to evaporate but without explosion. Suddenly heated it will burn with a sooty flame, somewhat like tar, but will cease burning as soon as the source of heat is removed.

According to the experiments of Mr. WERNER CROUQUIT made for the Swedish Government, under a powerful blow with a steel hammer on a metal plate bellit becomes heated but neither explodes or ignites. Two grains of bellit in a copper cartridge were placed on an iron plate and subjected to a fall of 200 lbs. from a height of 17½ ft. without exploding it. Many similar experiments proved the same characteristics.

Granulated bellit is fully exploded by a small quantity of fulminating mercury even when only covered with thin tin. It is well adopted for grenades when provides with a proper percussion tube. Compared with gun-cotton, the bellit showed a superiority of 10.4 per cent. at 17½ ft. distance, and 15.2 per cent. at 12½ ft. distance.

Progress on the New Croton Aqueduct.

The official report of the Chief Engineer of the New Croton Aqueduct, to July 16, 1887, shows the following summary of progress and present condition of the work:—

Miles of tunnel excavated to date	27.5444
Miles of open-cut " " "	1.0565
Total miles excavated	28.6009
Miles of unexcavated tunnel	2.2493
Total length of aqueduct	30.8502

Of the work done and to be done, as divided between the several contracts, we have the following:

	Tunnel excavated.	Unexcavated.
	Lin. ft.	Lin. ft.
Brown, Howard & Co.	61,466.9	4 902.0
O'Brien & Clark.	49,717.5	4,644 0
Heman Clark.	23.960.0	172 0
John Brunton & Co.	9,739 0	2,161.0
	144,883.4	11,879.0

The total advance made on the above contracts in the week ending July 16, was 909 lin. ft., or 0.1722 miles, in 27 headings. The general average advance on these 27 headings, for the week, was 33.7 lin. ft.; with 52 lin. ft. as the average of 5 headings on O'Brien & Clark's contract, and 28.9 lin. ft. as the average for 12 headings on Brown, Howard & Co.'s work.

Between Shafts 1 and 2 there are still 1,407 ft. to be excavated; between 2 and 3, 1,285 ft.; between 3 and 4, 717 ft.; between 13 A and 14, 2,647 ft., and between Shafts 27 and 28, 1,170 ft. Basing estimates upon the average weekly advance, the three first sections will be completed before Jan. 1, 1888; while the section between 27 and 28 will not be driven until April 1, 1888, and the one-half mile between 13 A and 14 will require until the middle of July, 1889. The condition of the masonry lining of the aqueduct stood as follows on July 16:—

Class of Work.	Lin. Ft. of Masonry Laid, July 16, 1887.				
	Brown, Howard & Co.	O'Brien & Clark.	Heman Clark.	J. Brunton & Co.	Total Aqueduct.
Invert.	9,521 0	1,391.0	13,362.0	None as yet.	24,274.0
E. Wall.	35,080.5	25,902.0	1,837.0		62 819.5
W. Wall.	36,204.5	25,895.0	1,837.0		63,936.5
Arch	27,313.0	22,368.0	13,398.0		62,979.0
	Lin. Ft. of Masonry still to be Laid.				
Invert.	57,308.9	52,970.5	10,723.0	11,900.0	132,902
E. Wall.	31,756 4	28,369.5	11,160.0	11,900.0	83,185
W. Wall.	30,572.4	28,309.5	11,160.0	11,900.0	82,031
Arch	39,515.9	32,093.5	10,734.0	11,900.0	94,243

We expect very shortly to show in detail the difficulties encountered on several of the delayed sections and also the means used for overcoming the same.

Some very fast tunnel-driving was done at Shaft 16, of the New Croton Aqueduct, in the week July 16 to 23 inclusive. In this week a progress of 127 lin. ft. was made; 2,050 lbs. of 60 per cent. dynamite being used in the 18 "shots," and 958 cars of muck hoisted. During these seven days there were the usual incidental delays, from the breaking of blasting wires, an air-tank taking fire, and the bursting of air-pipes; a somewhat more serious loss of time resulted from a strike among the muckers, and a new gang had to be organized. We have no details as yet as to character of rock, but the section was the normal one, we understand, and the drills used were of the "Rattler" pattern. This record eclipses in lineal feet any weekly run yet made on the aqueduct, the best monthly record, as we remember it, being 326 ft. in Shaft 15 last January. And in the same month 189 ft. were driven in two weeks at Shaft 20.

Mining Debris in California Rivers.

In the last Proceedings of the Technical Society of the Pacific Coast AUG. J. BOWIE, JR., presented a very elaborately treated and complete paper upon the deposit of mining debris in the California rivers, a subject of much present interest to the people and Federal Courts of that State. Space permits only a brief abstract of this interesting paper.

The purpose of Mr. BOWIE is to invite a discussion of the ways and means by which the present deplorable state of affairs can be improved, and to demonstrate what engineering science can do in this direction, from the surveys made and experience already gained. The practical question is—whether it is possible to permanently impound mine debris and prevent it from entering navigable streams, without check to mining, or detriment to agricultural interests. Upon the solution of this question depends the future of mining interests in California, in which over $100,000,000 are now invested in gravel mining alone.

The author then proceeds to describe the topography of the mining fields in the great valleys of the San Joaquin and Sacramento rivers and in the gravel deposits flanking the west side of the Sierra Nevada Mountains from Plumas Co., in the north to Mariposa Co. in the south. The mining area effected covers about 18,000 sq. miles, and the general rise from Sacramento City to Folsom, at the foot of the Sierra, is nearly 200 ft. in 18 miles. The Sacramento valley has an area of 4,769.09 miles; and the catchment areas with the drainage tributary to the Sacramento exceed by 2½ times the area of the valley itself. The Sierra Nevada side has an area of 8,843 sq. miles with elevations as high as 11,000 ft. and receives annually from 24 to 102 ins. of precipitation from snow and rain. In the valley proper, over 4,769 sq. miles, the average rainfall is from 18 to 20 ins. The Coast Range, flanking the valley on the west has an area of 3,075 sq. miles, with less rainfall than on the east; while the mountainous region north of the Sacramento plain, including Mt. Shasta, (14,440 ft. high) has an area of 5,616 sq. miles and a rainfall varying from 30 to 110 ins. To this must be added the Pitt River drainage area of 4,597 sq. miles excluding Goose Lake basin. This makes the grand aggregate area of the Sacramento basin at Collinsville, 26,187 sq. miles. Three-fourths of this area is mountainous, and the average rainfall for the mountain section may be taken at 35 to 40-ins. and for the total area of the basin at 30-ins.

About one-half of the total rainfall in latitude 38° occurs in November and December. Going north precipitation increases, going south it decreases. There is not a single permanent flowing stream on the west side of the San Joaquin from the Coast Range, and nearly the same is true for the Sacramento. From a study of the topography it is clear that the water-ways of this section of the State are wholly inadequate to discharge at high flood the drainage of the country.

Mr. BOWIE then considers the mining area of 18,000 sq. miles, and the amount of debris discharged from the mines annually. While the gold production of California has reached as high as $81,294,700 (in 1852) and was $30,000,000 in 1880, in 1885 it was only $13,000,000. The falling off is accounted for by the stoppage of the gravel mines. The quantity of auriferous gravel on the flanks of the Sierra Nevada is practically unlimited, but only a comparatively small portion can be regarded as workable under existing conditions. These conditions are outlined by the final decree of Judge SAWYER, of the U. S. Circuit Court, 9th. Circuit, (1884) in which a number of mining companies are perpetually enjoined and restrained from discharging gravel into the Yuba river its forks or branches; and this decree also prohibits any other party from using the water supply of these mines for mining purposes. This decision, of course, applies to all classes or kinds of mining in this region.

The State Engineer, in his report of 1880, estimated that 15,122,000 miners (24 hours) inches of water were used per annum in hydraulic mining on the streams draining into the Sacramento valley, and 53,404,000 cub. yds. of material of all kinds were washed out by its use. Mr. BOWIE notes great discrepancies in the reports upon this head as officially made by the State and United States authorities,

and quotes a later and more reliable report on the largest and most important gravel mines—those on the Yuba—as using only 3,250,000 miners inches annually to move 11,375,000 cub. yds. of material.

In regard to drainage done on the Yuba and Feather rivers, the region chiefly effected, the official report for 1880 shows 43,546 acres of land depreciated in value to the extent of $2,597,634. This estimate is based altogether upon hearsay evidence. The estimated loss to the State in taxes on this land is $7,143.18 per annum. The State Engineer says that these large bodies of land are now more valuable than before the stream beds were raised by debris; they have been rendered moist and tillable in a high degrees by raising the sub-surface waters. On the other hand the yield of the mines in this one section of the State, has probably exceeded $600,000,000.

From the evidence in the famous case of Woodruff *vs.* North Bloomfield *et al.*, it appeared that about 30 per cent. of all the material mined passed down into the main river, and that 65,000,000 cub. yds. per day passed Maryville in suspension. Mr. BOWIE proceeds to demolish these estimates by proving them absurd. But he says that the average depth over the 16,000 acres in question was approximately from 15 to 25 ft., and the probable quantity of debris deposited was from 387 to 645 millions of cub. yds. Mr. BOWIE says that all such estimates are at best only guesses; but that glaringly incorrect as they are, judgments have been rendered upon them throwing thousands of people out of employment and destroying millions of property.

The author next discusses the ancient and present lines of drainage and says that the area drained by the present streams does not differ essentialy from that drained by the pliocene rivers. The existence of larger channels shows that the flow from corresponding areas was greater during that period than it is now. It is said that in early days the present streams were clear running water in their ordinary stage between high banks. No change was noted in their beds or slopes until the flood of 1862, and subsequent floods increased the evil until in 1869 the low-water reading of the Sacramento tidal-gauge showed an increase of 2.9 ft. above zero. In investigating the sources whence this material came, it should be remembered that in the early days of placer mining over 100,000 men were engaged in washing for gold in streams tributary to the Sacramento, and they necessarily discharged an enormous quantity of material into the smaller streams. These accumulations, and that from subsequent mining, have undoubtedly been transferred by floods to the streams below and assisted in raising the beds. This once accomplished, the slightest subsequent change was readily noticed and every evil accruing therefrom was immediately attributed to hydraulic mining.

Mr. BOWIE then shows by comparison with other rivers of the world and owing to the natural conditions existing in the bed and course of the Sacramento and its tributaries that an enormous quantity of material is annually moved by causes purely natural and entirely distinct from mining enterprise. As evidences he cites the gradual filling of the bays of San Francisco and San Pablo, the raising of land at Caliente and Los Angeles, and other points where mining does not exist. He charges much of this change of condition to the cutting of trees from the mountain sides, the unrestricted pasturage of stock and the work of the farmer.

In noting the effect upon navigable rivers the author says that the low-water plane of the Sacramento has been evidently raised 7 ft. since 1849. And he then proceeds to discuss the changes going on in San Francisco Bay which discharges the drainage of 62,086 sq. miles of territory. The total tidal area tributary to Golden Gate at extreme high water is 740 sq. miles and of this 300 sq. miles is marsh land at the level of ordinary high water. Of the 440 sq. miles 200 sq. miles have a low water depth of less than 6 ft. The present condition then of the great bay is that of the 740 sq. miles of tidal area, 300 have been made land by natural causes, and of the other 440 sq. miles one-quarter has been sold by the State to corporations and others. On the Oakland side the U. S. Government has a solid stone jetty extending out 9,750 ft., the Central Pacific R. R. Co. has a pier 2¾ miles long to the 24 ft. contour and the South Pacific Coast R. R. has another pier still longer. It is only a question of time when all the land between *terra firma* and the outer ends of these piers will be shoaled by the mass of material washed down from the mountains in the rear of Oakland and the country between, which would otherwise be distributed over the bay were not the scour of the tides effectually stopped. The enormous tidal discharge at the Golden Gate—nearly four times the ordinary discharge of the Mississippi river will, however, by its scouring action preserve the bay.

To successfully prosecute mining and harmonize it with the at present conflicting interests, we must have full information upon the following points:

1st. Accurate and detailed surveys of the whole field, including sources of water supply, discharge of all streams, and their flow and geological action. 2nd. The present, and probable amount of detritus discharged from mines, etc. 3rd. Information as to sites for barriers and reservoirs, and best form of these. 4th. What legislative action is required to obtain land for same. 5th. Estimates of cost of erecting and maintaining necessary impounding works.

No such complete surveys have yet been made, but Mr. BOWIE, from the best data available, proceeds to the discussion of sites for barriers as suggested by the existing conditions, and enters minutely into each case. He proposes to use for these barriers lines of brush-work, wooden cribs filled with stone, or masonry or rubble-work as the case may require. The object of these barriers is not to impound water but to simply arrest and store sand, etc., behind them. As proving the durability of such dams, Mr. BOWIE points out the Madras dam across the Kaveri river; this dam is 1,080 ft. long, 40 to 60 ft. broad, 15 to 18 ft. high, is built of large, rough stone and has stood over 1,600 years.

The legal questions involved, must be left to others than engineers for solution. As to the cost of such barriers, the following estimates for a debris barrier proposed at Point du Guerre, Cal., will indicate it approximately: Dam, 10 ft. high, 10 ft. crest, $30.86 per lin. ft.; 6 ft. high, 10 ft. crest, $12.07 per ft.; 5 ft. high, 8 ft. crest, $9.49 per foot. In this case 21 dams, costing $345,380, had a storage capacity of 61,800,000 cu. yds. of debris,

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 65.

Galena, Ill.—The works were commenced Oct. 15, 1886, and accepted May 25, 1887; they were built by C. A. Lamb and H. S. Raymond, of Chicago. H. S. RAYMOND, C. E., was the Engineer in Charge. The supply is drawn from an artesian well 1,530 ft. deep, flowing between 1,800 and 2,000 galls. per minute; there are two duplex pumps built by E. Smedley, of Dubuque, Ia.; the system is combined direct pumping and stand-pipe. The water is reported to be very pure and soft. There are 6 miles of cast-iron pipe, mostly in rock trench, and 70 Ludlow hydrants. The franchise is owned by the Galena Water Co.; President, C. A. LAMB; Secretary, H. S. RAYMOND; the term is 30 years and the city's contract is about $3,000.

Fishkill and Matteawan, N. Y.—The works were commenced Aug., 1886, and accepted, June, 1887. GEO. B. INMAN was the Engineer. The contract for the entire work, except the dam and reservoir, was taken by Inman Bros.; the dam and reservoir were built by Mr. BAILEY, the President's engineer, under contract. The pipe and specials were supplied by the Warren Foundry & Machine Co., Phillipsburg, N. J.; the Mathews hydrants and Ludlow valves were used. All the material was furnished and all work performed by Inman Bros. for stock and bonds. The franchise is owned by the Fishkill & Matteawan Water Co.; President, F. HOPKINSON SMITH; Secretary, G. D. L'HUILLIER; Superintendent, J. W. PHELPS. The franchise is for 20 years and provides for 45 hydrants at $50 per annum. The present population is about 15,000.

(TO BE CONTINUED.)

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

Albany, N. Y.—With regard to our note on page 14, we are now asked to correct that correction by stating that Mr. MARS is, and has been for the last 12 years, engineer to the Board of Water Commissioners.

Land Reclamation.—At Starke, Fla., a project is on foot to lower the water in three lakes near the town by 4 ft., and thus reclaim about 10,000 acres of land.

The Brooklyn Heat & Power Co. has been incorporated by DELMORE ELWELL, Brooklyn, N. Y.; DAVID B. PARKS, Randolph, N. Y., and THEODORE M. VAIL, Boston, Mass. Capital stock, $25,000.

Fernandina, Fla.—By a recent law of the State the city charter was abolished and a new charter went into effect. The legality of both acts is questioned and therefore nothing can at present be done with reference to the bids for water-works which were advertised some time ago.

Jerseyville, Ill.—The works recently contracted for by George C. Morgan, of Chicago, will include 4¼ miles of mains, 2 boilers and pumps, well, reservoir and a tower 13 ft. diameter and 116 ft. high, 80 ft. of brick and 36 ft. of iron.

Irrigation in California—The West Side Irrigation & Improvement Co. has been incorporated at San Francisco by JAMES A. MORELAND, of that city; B. C. HAWES, H. C. HOTE, WM. STRADER and J. W. PEW.

It is reported that Senator JOHN P. JONES, of Oakland, will put the Clear Creek ditch in operation. The ditch is 30 miles long.

Artesian Wells.—Wilton, Ia.—A company has been incorporated to bore artesian wells.—Houston, Tex. Good water has been struck at a depth of 140 ft.—Fall River, Mass. The well of the Globe Yarn Co. has struck water at a depth of 227 ft.—Marshall, Ill. An artesian well is being bored.—The Texas & Pacific R. R. Co. will expend about $50,000 in securing a complete system of water supply along its line. Artesian wells are to be sunk at Sherman, Paris, Honey Grove, Texarkana, Bonham, Fort Worth, Big Springs, Sierra Blanca, Eagle Flat, Berache, San Martine, Pyote, Metz and Vista.

Water Works Improvements and Extensions.—*New York.*—Rome. The Water Commissioners will put in 2 new water-wheels of 150 H. P. each, and make other improvements.—*Ohio.* Cincinnati. Superintendent MOORE has been directed to suggest some remedy for the deficiency in the water supply.—Cleveland. The two new Knowles pumps will be in place in the old pumping station, on West River street by September 1; their daily capacity will be 15,000,000 galls. each, and steam will be supplied by six new steel boilers.—Norwalk. The water very nearly gave out a few weeks ago, and the works were shut down for a while. The stream that supplies the reservoir is unequal to the demands and wells are to be bored to obtain an additional supply.—*Texas.* Fort Worth. The mains have been extended 30,000 ft., and an additional pump and a filter will be put in at a cost of $60,000, and $40,000 respectively.—Galveston. Morgan Jones, of Fort Worth, the owner of the water-works, whose contract expired July 15, has leased the works to the city for 3 months for $500 and C. E. JOHNSON, the Superintendent and Chief Engineer of the works, will run the works for the city, assuming all the responsibility, for $500 per month.—*Canada.* Kingston. The ratepayers will vote Aug. 10 on the by law for the purchase of the water-works. The company does not desire to sell, but has no option if the action of the Council is endorsed by the people.—Toronto. Superintendent HAMILTON is preparing plans for a new reservoir on Wells Hill to be supplied by new pumps to be established at Mimico.

Jeffersonville, Ky.—Propositions for the establishment of water-works were received recently from the Jeffersonville Water-Works Co., President J. H. McCAMBELL, and Samuel R. Bullock & Co., of New York. The former company proposed to lay 9 miles of 4 to 12-in. pipe, erect a steel or iron stand-pipe not less than 3 ft. diameter and 150 ft. high, and put in 2 pumping engines with an aggregate daily capacity of 2,000,000 galls.; the city to take 108 hydrants at an annual rental of $6,480, and the works to be completed by January. Bullock & Co. proposed to lay 10 miles of 6 to 14-in. pipe, erect a steel stand-pipe 15 ft. diameter and 150 ft. high, and put in 2 pumping engines with an aggregate daily capacity of 3,000,000 galls.; the city to take 110 hydrants at an annual rental of $6,350, and a local company to be organized; work to be completed in a year. The Council referred the matter to a committee, which reported that after examining the plans, specifications and propositions, they were unanimously in favor of Bullock & Co's proposition. The report was adopted, and an ordinance prepared and accepted granting a franchise to Samuel R. Bullock & Co. for 30 years.

Sanitary Inspectors.—The New York Board of Health has adopted a set of rules for the inspectors.

Boston, Mass.—The old 6-in. main on Washington street, between Milk and State streets, has been taken up and replaced with a 12-in. main for the high service system. The old pipe was laid at the time of the introduction of Cochituate water in 1847 and was still in good condition. Near Milk street several wooden pipes were discovered; they were originally stout spruce logs, about 5 ins. bore, but when discovered they were entirely decayed and soft, though still preserving their shape, the iron bands which bound them together were still in place. These pipes were laid in the early part of the century by the Jamaica Pond Aqueduct Co., which gave Boston its first water service.

Water Companies.—Old Orchard Water Co., Old Orchard, Me. President, A. B. TURNER. Capital, $75,000.

Mansfield Water Co., Mansfield, Mass. President, D. S. SPAULDING; Vice President, J. W. ROGERS; Secretary, J. E. WHITE. Capital subscribed, $30,000.

Skaneateles Water Co., Skaneateles, N. Y. JOHN E WALLER, B. E. PETHERAM, and others. Capital, $40,000.

Chester Water Co., Chester, Pa. The south ward works have been formally transferred to this new company.

Catonsville Water Co., Catonsville, Md. President, JOSEPH M. CONE: Secretary, MELVIN CONE. Capital subscribed, $23,000.

Cypress Water-Works Co., Florence, Ala. President, ANDREW BROWN; Vice President, M. B. SKELTON; Secretary, J. B. WHITE.

Alabama Automatic Water & Gas Co., Birmingham, Ala. President, F. SLOSS; Vice President, J. E. DU BOIS; Secretary, H. M. MCNUTT; General Manager, W. H. ROSE. Capital stock, $250,000.

Tallapoosa Water-Works Co., Tallapoosa, Ala. I. M. WATSON, J. P. MILLER, and others. Capital stock, $10,000.

Glasgow Water Co., Glasgow, Ky. The company will probably shut down, having operated the works at a loss.

Jeffersonville Water Supply Co., Jeffersonville, Ind. EMIL WOLTEN, E. C. BUTCHER and C. BERRIAM. Capital stock, $200,000.

Cloquet Water Co., Cloquet, Minn. F. P. THOMPSON, J. L. MCCULLOUGH and others. Capital stock, $20,000.

Oak Cliff Water Supply Co., Dallas, Tex, President, F. L. MARSALIS; Vice President, T. FIELD; Secretary, FRANK FIELD. Capital stock, $50,000.

The Philadelphia Water Department.—Chief Engineer OGDEN has just issued his annual report for 1886. The income of the bureau was $1,908,733, or $101,562 more than in 1885. 28,658 millions of gallons were pumped, or 3,493 million more than in the previous year. The maximum pumpage in any one day was in July, 102,202,857 galls., and the daily average was 78,433,289 galls. The cost of pumping 1,000,000 galls. was $46, for which the bureau received $61.86. In view of this somewhat excessive profit Chief OGDEN recommends a reduction of rates. He also, like his predecessors, recommends the completion of the Cambria basins. In the year 258,041 ft. of pipe were laid, 295 hydrants set, and 8,009 services attached. He thinks, that with proper settling basins provided, the Schuylkill water will answer for some time yet, as chemical analysis is not reliable, and the health reports show little to fear, and prove that the mortality for Philadelphia is less than London, Paris or New York. He recommends filtration to remove the clay and foreign matter in suspension, and deposit in the reservoirs and distribution thus avoided, the latter especially decreasing the supply. Mr. OGDEN suggests coke as efficient and also that certain parties be permitted to erect trial filtering plants as proposed by them. As to future supply, Mr. OGDEN thinks the present sources can be depended upon until 1910, and possibly longer, but he advises the continuation of the investigation, so ably carried on by Mr. RUDOLPH HERING, and its extension to other water sheds.

New Water Works.—*Maine.*—Eastport. The water company has failed to obtain water from wells, and will have to pipe the supply from Boyden's lake, 7 miles distant. This means that the city will have to pay $4,000 instead of $2,000 per annum for hydrants.—Skowhegan. Work will be commenced in August.—*New Hampshire.* Hanover. The committee has reported in favor of a gravity system at a cost of $35,000, and has been instructed to apply to the legislation for a charter.—*Massachusetts.* Marblehead. The Marblehead Water Co. has contracted to supply the town for 5 years.—Saugus. The town has arranged for a water supply for 5 years from Lynn.—Malden. A committee has been appointed to investigate the cost of obtaining water from Martin's pond and dredging at Spot pond, whence the present supply is obtained; also the expediency of trying driven wells. The issue of $25,000 water bonds has been authorized.—*New York.* Albion. Water-works are to be established and works completed within a year.—*North Carolina.* Asheville. Much trouble has been caused at the new works by frequent bursting of the pipes; the supply is taken from the Swannanoa river.—*Alabama.* Mobile. Pipe laying is progressing and water will be turned on in about a month.—*Illinois.* Hillsboro. The issuing of bonds for $25,000 for water works will be voted upon Aug. 3, and a favorable result is expected.—*Missouri.* Lamar. The Lamar Gas & Water Co. has invited proposals for the franchise, and opened the bids yesterday.—*Wisconsin.* Manitowoc. Water-works are to be established. Address Mayor TORRISON.—*Colorado.* Berthoud. The Michigan Pipe Co. is laying the mains and the works will soon be completed.—Grand Junction. There is considerable agitation in favor of water-works.—*Nebraska.* Blair. A test of the water supply is to be made shortly under order from the Court, in consequence of a suit by Fairbanks & Co., the contractors, for $10,000, as balance due.—*California.* Pasadena. Water-works are needed.—San Francisco. The Amador Ditch Co. proposes to pipe an additional supply from a lake 20 miles from Sonora through a 48-in. main. The distance is 120 miles, and Oakland and San Jose would have branch lines to the main pipe.—*Texas.* An ordinance has been passed authorizing the issue of bonds for $150,000 for a new system of water works.—*Nova Scotia.* Water-works are being constructed at Bridgetown, Kentville and New Glasgow.

Bad Water at Exeter, N. H.—The water furnished by the Exeter Water-Works Co., which was established by a syndicate about 8 months ago, has given cause for much complaint, being very impure. Recently the Board of Health made an investigation and sent samples to Prof. ANGELL, of Derry, for analysis. In his report the Professor pronounced its impurity of the worst type, unfit for any purpose, full of animal and vegetable matter; also that the water from the wells was impure. At a hearing July 20th, the Board of Health ordered that no more water be drawn from the pond the pipes to be flushed and hereafter to take the supply of water from their wells. It is understood that the company will try a filtering process to purify the pond water, and if possible supply the public with pure water.

Proposals Open.

Water Works.—Proposals for the purchase of the city water-works. THE WATER COMMITTEE, St. Cloud, Minn.

City Work.—Street improvement and sewers. P. C. HILLIARD, Chairman, Committee on Streets and Sewers, Board of Public Works, Jersey City, N. J. August 1.

Sewer and Street.—Plans and specifications on file. C. B. HAYWARD, City Clerk, Dayton, Ky. August 1.

Bridge Railing.—Lattice railing on Connecticut river bridge between Northampton and Hadley. Plans and specifications at the office of S. C. DAVIS, Northampton. E. N. FOOTE, Chairman, Bridge Committee, Northampton, Mass. August 1.

Bridge Work.—For constructing the unfinished portion of the main piers of the Grand avenue bridge, and building with said piers the iron work necessary for the connection with the superstructure. Plans and specifications at the office of the Street Commissioner. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. August 2.

Sewers.—JOHN HUNKELE, Street Commissioner, Newark, N. J. August 2.

Granite.—Dressed granite for main court building, 140,000 cu. ft. THE COURT HOUSE COMMISSIONER'S, Boston, Mass. August 2.

Water Works Supplies.—Iron sluice gates, two 4 × 4 ft., six 3 × 3 ft., two 30 by 30-in., one 18 × 18-in.; one floor gate; stopcocks, seven 30-in., six 24-in., six 20-in.; two 24-in. check valves. Plans and specifications at the office of the City Engineer. H. T. ROCKWELL, Chairman, Water Board, Boston, Mass. August 3.

Trenching and Pipe Laying.—RUDOLF EICKEMEYER, President, Board of Water Commissioners, Yonkers, N. Y. August 4.

Pipe and Hydrants.—Iron water pipe, 820 ft. of 10-in., 10,250 ft. of 6-in.; 25 Wood's hydrants. Plans and specifications at the office of the City Engineer. W. B. DAVIS, City Recorder, Mankato, Minn. August 4.

Masonry.—At Pier A. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. August 5.

Bridge and Shaft.—Canal bridge to carry a water pipe; enlargement of shaft at the inlet pier. THE WATER COMMISSIONERS, Buffalo, N. Y. August 6.

Water Pipe, Etc.—Cast-iron water pipe, branch pipes and special castings. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. August 9.

Sewers and Street Work.—THE COMMISSIONER OF PUBLIC WORKS (*as above*). August 9.

Jail.—Of wood, or brick and stone. Plans and specifications on file. JOHN J. JONES, Chairman, Committee on Roads and Revenues, Waynesboro, Ga. August 9.

Court House and Jail.—Plans and specifications on file. S. S. LUTHER, County Auditor, Altkin, Minn. August 10.

Street Work.—THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. August 10.

Buildings.—Brick city hall and two fire engine houses. J. D. NORMAN, Mayor, Union Springs, Ala. August 15.

Electric Lighting.—J. T. MCPHERSON, Chairman, Lighting Committee, Cambridge, O. August 15.

Water Works.—W. H. BEHRENS, City Clerk, Carlinville, Ill. August 15.

Bridge.—Across Niobrara river, one span of 96 ft. or two of 48 ft.; roadway 14 ft. wide. Bidders to furnish plans and specifications. GEO. L. FISCHER, County Clerk, Valentine, Neb. August 17.

Court House and Jail.—Plans and specifications on file. Cost not to exceed $18,000. JOHN A. PERCIVAL, County Clerk, Devils Lake, Dak. August 18.

Water-Works.—For works complete, or for furnishing different articles, stand-pipe, pumping plant, pipe, etc. Plans and specifications on file. JAS. H. CORTEL, Mayor, Marshall, Tex. August 18.

Repairing Wharf.—Lieut. CHAS. G. WOODWARD, Act. Asst. Q. M., Fort McHenry, Md. August 18.

Lumber and Ties.—Specifications to be obtained of JOHN TAYLOR, General Storekeeper, Grand Trunk Ry., Montreal. JOSEPH HICKSON, General Manager, Grand Trunk Ry., Montreal. August 25.

Levees.—New work, 764,000 cu. yds.; enlargements, 954,400 cu. yds.; total 1,718,400 cu. yds. Plans and specifications at the office of WILLIAM STARLING, Chief Engineer, Levee Board Building, Greenville, S. W. FERGUSON, Secretary, Board of Mississippi Levee Commissioners, Greenville, Miss. September 12.

Contracting.

Brick Conduit.—The Boston Heating Company has awarded contracts for the brick conduit to Putterill & Killian and Mark Wilmarth. JASPER N. KELLER is General Manager.

Water Works.—The time for receiving proposals for the water-works at Carlinville, Ill., has been extended to August 15. Address W. H. BEHRENS, City Clerk.

The Dominion Subway Co. has been incorporated at Montreal, Canada, with a capital stock of $100,000, to construct and operate underground conduits for electric wires, etc.

Sewerage System.—Sykes & Co. have been awarded the contract for the construction of the sewerage system at St. Cloud, Minn., and will commence work at once.

Crushed Stone.—The following proposals have been received at Sandy Hill, N. Y.: A. J. Howell, trap rock, $2.36 per gross ton; granite, $2.05; blue stone, $1.97. P. Callanan, limestone, $2.50 per cu. yd. D. M. Monty and J. E. Flood, Kingsbury bluestone, $1.70 per cu. yd. Contract awarded to P. Callanan.

Pumping Plant.—The following proposals for engine and boilers have been received by LOUIS LESAGE, Superintendent of Water-Works, Montreal, Canada: Blake Manufacturing Co., Boston, Mass., $12,086, $20,600; H. R. Worthington, New York, $20,200; Holly Manufacturing Co., Lockport, N. Y., $21,180; E. E. Gilbert & Sons, Montreal, $22,500. The proposals were for an engine with a daily capacity of 2,000,000 galls. pumped to a height of about 225 ft.

Removing Ledge.—The following proposals for removing ledge from Moose-a-bec Bar, near Jonesport, Me., were received July 22 by Major JARED A. SMITH, U. S. Engineer Office, Portland, Me.: Louis E. Lunt, Portland, $16.20 per cu. yd. in situ; Geo. W. Townsend, Boston, $24.83; John F. Hamilton, Portland, $26. Contract awarded to Louis E. Lunt.

Riveted Iron Mains.—The Spring Valley Water-Works Co., San Francisco, Cal., recently advertised for proposals for about 4,000 tons of plate iron and 3,000 kegs of rivets for mains to connect the Crystal Springs reservoir with the distributing reservoirs in the city. The contract has been awarded to Holbrook, Merrill & Stetson, for about $400,000.

Bridge Masonry.—The contract for rebuilding the piers and abutments of the Union street bridge over the Merrimac river at Lawrence, Mass., has been awarded to Michael O'Mahoney & Co.; granite, $24.50 per yd.; rubble stone, $5.75; rip-rap, 75 cts.

Pier.—COFRODE & EVANS, Contracting Engineers, of Pottstown, Pa., are building a coal and shipping pier for the North River Coal & Wharf Co. at Communipaw, Jersey City. The pier is 1,800 ft. long by 40 ft. wide, containing about 3,400 piles, and 1¼ million feet of yellow-pine timber.

Grading and Paving.—*Brooklyn, N. Y.*—The following proposals were opened July 25 at the Department of City Works: Grading and cobblestone paving on Evergreen avenue; John Hart, $4.66 per lin. ft.; John J. O'Brien, $4.35; John Hennessey, $3. On Wyckoff avenue; John Hart, $4.47 per lin. ft.; Harris & Maguire, $4.46; John Hennessey, $3.05; John N. Booth, $2.94.

Artesian Wells.—J. C. Harte has the contract to drive 13 artesian wells at Bessemer, Ala.

Dams.—The Winsted Electric Light Co. is constructing a dam at Great Falls, about 3½ miles from Winsted, Conn., for power to run the dynamos. There will be a Hercules turbine water-wheel on a horizontal shaft, and the power will be taken direct from this shaft to the dynamos. The dam will be 23 ft. high and the total head will be 51 ft. Hull & Palmer, Bridgeport, Conn., are the engineers.

T. J. Emery, Waterville, Me., has the contract for the new dam for W. T. Pearson & Co., to replace the one washed away.

Laying Water Pipe.—At Providence, R. I., the contract for trenching, laying and back filling complete a line of pipe from the Hope pumping station to near the proposed Fruit Hill reservoir, has been awarded to James J. Newman of Providence, at the following prices: 6-in. pipe, 35 cts. per lin. ft.; 8-in., 40 cts.; 12-in., 50 cts.; 16-in., 70 cts.; 24-in., 77 cts. Cartage, 70 cts. per ton of 2,000 pounds.

Dam and Reservoir.—The contract for the construction of a dam and reservoir on Roaring brook, at Dunnings, near Scranton, Pa., for the increased water supply of the Scranton Gas & Water Co., was awarded July 21 to Burke Bros., of Scranton. The reservoir will have a capacity of about 700,000,000 galls., and the plans and specifications were prepared by E. SHERMAN GOULD, M. Am. Soc. C. E., under whose supervision the work will be executed. Burke Bros. are constructing, and have nearly completed, a smaller reservoir, with a capacity of 350,000,000 galls., for the same company; this reservoir was also designed and superintended by Mr. GOULD.

Street Work and Sewers.—*New York City.*—The following contracts were awarded by the Department of Public Works, July 22: Taking up and relaying pavement in Wall, 55th, 56th, 57th, 79th and 83rd streets: Geo. F. Doak, pavement, 42 cts. per sq. yd.; bridge stone, 69 cts. per sq. ft.; total, $7,885.80.—Taking up and relaying pavement on 31st, 32nd, 34th, 36th, 39th, 42nd and 43rd streets, Geo. F. Doak, 44 cts., 60 cts., $5,491.48.—Regulating, grading, curbing and flagging on 90th street, Andrew Low, earth and rock excavation, 40 cts. and $2.50 per cu. yd.; filling, 15 cts per cu. yd.; curbing, 60 cts. per lin. ft.; flagging, 26 cts. per sq. ft.; total, $2,411.20.—Sewer in 103rd street; Patrick Kearns; sewer, $3.40 per lin. ft.; rock excavation, $4 per cu. yd.; total, $3,396.20.—Sewer in 104th street; John McKim & Son, $3.34, $4, $3,442.62.

Reservoir and Pipe Laying.—The following proposals have been received by the Trustees of Covington reservoir, Covington, Ky.: For constructing reservoir; Huston, Freeman & Co., Cincinnati, O., $286,960.55; Peter, Scully & Cram, Cincinnati, O., $316,377.44; McRitchie & Nichol, Chicago, Ill., $335,229.60; Marshall Morris, Louisville, Ky., $358,468.88; D. F. Minehan, Springfield, O., $397,659.43; E. Cummings, Covington, Ky., $425,000; McRae & Lally, Lockport, N. Y., $427,236; Charles M. Steel & Son, Cincinnati, O., $432,694.92. The contract was awarded to Peter, Scully & Cram, Cincinnati, O.

For pipe laying for reservoir; H. N. P. Dole & Co., Columbus, O., $42,788.45; McRae & Lally, Lockport, N. Y., $56,304.90; James H. Harlow, Pittsburg, Pa., $84,124.80; McRitchie & Nichol, Chicago, Ill., $85,517.20; Waite, Van Hartingen & MacTier, Philadelphia, Pa., $130,623.76. The contract was awarded to McRae & Lally, Lockport, N. Y.

Sewers.—*New Haven, Conn.* Contracts have been awarded by A. B. HILL, City Engineer, to A. Brazos & Sons, $2,434.50, $1,370.50, $1,210, $612 and $945.70; L. O'Brien, $6,020; Matthew Kehoe, $4,317.30. The contract prices were; 30-in. sewers, $5; 24-in., $4.25, $3.65, $3.50; 18-in., $1.98; 15-in., $1.70, $1.65, $1.58; 12-in., $1.50, $1.12, $1.10; 12-in. culvert, $1.50, $1.25; catch basins, $100, $110, $115; manholes, $60, $50, $48, $40.

Birmingham, Ala.—The following proposals have been received by J. R. CARTER, City Engineer; G. Krupp & Co., Louisville; brick laid, $8.60; earth and rock excavation, 40 cts., and $3.75; Dunn Bros., Birmingham, $9.95, 40 cts. $1.35; John McPoland, Birmingham, $7.65, 33½ cts., 85 cts.; Andrews & Schofield, Birmingham, $8.25, 55 cts., $1.75; McCandless & Co., Louisville, $9.60, 58 cts., $3.75; W. H. Hawkins & Co., Louisville, $7.85, 35 cts., $1.85; Jennings & Donahue, Birmingham, $7.85, 28 cts., $1.10. The contract was awarded to W. H. Hawkins & Co.; aggregate bid, $2,886. Work to be completed by December. The city will furnish the brick, about 3,000,000 being required, and has contracted for 1,000,000 at $7.50 per 1,000. Common labor (10 hours) is worth $1.25 per day.

Albany, N. Y.—The following proposals have been received by the Board of Contract and Apportionment: Thomas Reilly, 12 and 15-in. vitrified pipe, 95 cts. and $1.15 per lin. ft.; Y-branches for 12 and 15-in. pipe, $2.96 and $3.96 per branch; manholes, $48 each; lampholes, $30 each; John J. Gallogly, $1.25, $1.62, $3.25, $4.80, $55, $7. Jacob Holler, $1.40, $1.60, $4.20, $4.50, $65, $25, John Doyle, 94 cts., $1.09, $3, $3.50, $60, $3.

The American Bridge & Building Co., San Francisco, Cal., has the contract for the iron and steel trestle work for a bridge, 3,000 ft. long, across Petaluma creek, for the San Francisco & Northern Pacific R. R. Co.; the California Bridge Co. having only the contract for the draw span and not for the entire work as stated on page 15. The American Bridge Co. has also a contract for a wharf and warehouse on the straits of Carquinez for Balfour, Guthrie & Co.; the wharf is 712 ft. long by 142 ft. wide; the warehouse is 688 ft. by 120 ft., two stories high, and is to be covered with corrugated iron. The contract price is $125,0000.

Pile Dike.—The following proposals for the construction of 2,200 ft. of dike at the harbor at Saugerties, N. Y., have been received by Lieut. Col. WALTER MCFARLAND, U. S. Engineer Office, New York City: Henry DuBois' Sons, New York, $6.79 per lin. ft., $15,617; Joseph L. Powley, Rondout, N.Y., $7.93, $18,239; John Satterlee, Englewood, N. J., $8.20, $18,860; Alexander Sturgeon, Kingston, N. Y., $8.85, $20,335; Stephen A. Kelly, Brooklyn, N. Y., $9.65, $22,195; Ross & Sanford, Jersey City, N. J., $10.40, $23,920; Richard Parrott, Newburg, N. Y., (informal). The contract has been awarded to Henry DuBois' Sons, New York.

Dredging.—The following proposals for dredging 150,000 cu. yds. in Raritan bay, N. J., have been received by Lieut. Col. WALTER MCFARLAND, U. S. Engineer Office, New York City: Morris & Cumings Dredging Co., New York, 24½ cts. per cu. yd., $36,750; American Dredging Co., Philadelphia, Pa., 26 cts., $39,000; Thomas Potter, Jersey City, N. J., 26 cts., $39,000; Atlantic Dredging Co., Brooklyn, N. Y., 23¾ cts., $35,625; P. Sanford Ross, Jersey City, N. J., 24½ cts., $36,750. The contract has been awarded to the Atlantic Dredging Co.

The following proposals for dredging 900,000 cu. yds. in the ship channel, Galveston bay, have been received by Major O. H. ERNST, U. S. Engineer Office, Galveston, Tex.; William Fagan, New Orleans, La., 9½ cts. per cu. yd.; Rittenhouse Moore, Mobile, Ala., 10 cts.; Geo. C. Forbes & Co., Baltimore, Md., 12.6 cts.; Bertrand Adon, Galveston, 16 cts.

The only proposal for dredging in the Maurice river, N. J., received by Gen. WM. F. SMITH, U. S. Engineer Office, Wilmington, Del., was from the American Dredging Co., Philadelphia, Pa., for 14 cts. per cu. yd., measured in situ.

Breakwater.—The following proposals have been received by Major M. B. ADAMS, U. S. Engineer Office, Burlington, Vt.: For constructing breakwater at Gordon's Landing, Lake Champlain, Vt.; William J. Daly, Ogdensburg, N. Y.; rubble stone, 84.9 cts. per cu. yd.; large stone, $2.20 per cu. yd.; piles and timber, 50 cts. per lin. ft.; bolts, spikes and iron, 6 cts. per pound; total, $15,15). Mark S. Leavy and John C. Buckley, Albany, N. Y.; 82.5 cts., $2.48, 98 cts., 9 cts., $16,119.90. John L. Johnson, Fulton, N. Y.; 90 cts., $2.39, 60 cts., 5 cts., $16,144.53. Nelson W. Fisk, Isle La Mott, Vt.; 83 cts., $2.68, 70 cts., 7 cts., $16,834.42. Stephen V. R. Hendrick, Richville, N. Y.; $2.50, $3.50, 40 and 50 cts. per lin. ft. for timber and piles respectively, 4 cts. per pound for drift bolts and spikes and 6 cts. for strap iron $31,927.88.

Extension of breakwater at Burlington, Vt.; Luther Whitney, Keeseville, N. Y.; hemlock timber, $24 per 1,000 ft. B. M.; white pine timber, $30; white oak timber, $80; drift bolts, 4 cts. per pound; screw and washer bolts, 12½ cts. per pound; stone, 79 cts. per cu. yd.; total, $16,399.64. John L. Johnson, Fulton, N. Y.; $24, $33, $40, 4 cts., 10 cts., 90 cts., $17,727.64. James B. Donnelly, Oswego, N.Y.; $23, $30, $50, 5 cts., 6 cts., 95 cts., $18,023. Mark S. Leavy and John Buckley, Albany, N. Y., $22, $30, $48, 9 cts., 8 cts., 93¾ cts., $18,750.99. Robert H. Rogers, Plattsburg, N. Y.; $30, $40, $40, 5 cts., 7½ cts., $1.23, $23,079.66. Stephen V. R. Hendrick, Richville, N. Y.; $24, $35, $50, 4 cts., no bid, 90 cts.

RAILROADS.

East of Chicago.

Existing Roads.—*New York & New England.*—Besides the New Haven & Derby line which W. H. STARBUCK has bought for this company, the control has been secured of the Shepaug road, running from Hawleyville, Conn., to Litchfield, and it will be extended north to a connection with the Hartford & Connecticut Western line, probably at Winsted, a distance of about 17 miles.

Midland of Indiana.—A surveying party is locating the line from Lebanon west 20 miles to Rockville.

Ohio & Mississippi.—The extension from Watson to New Albany, 7½ miles, is completed, and tracks are being laid to a connection with the Kentucky & Indiana bridge at the latter city.

Baltimore & Ohio.—Surveys have been made for a two mile branch to the village of Savage, Md. Events seem to show more and more clearly the intentions of the company with regard to the New York extension. Besides the surveys and the right of way procedures in reference to the Arthur Kill bridge, which have been generally known, it now transpires that through an agent the company has secured a large amount of valuable real estate on Staten Island for terminals, etc. The agent appears to have been successful in securing the property at a reasonable figure and by his principal's instructions he organized the Staten Island Transit & Terminal Co. But when the time came that the B. & O. thought they could safely "show their hand," and ordered the nominal owners to turn over the property to them, the agent, reckoning probably on their wish to avoid publicity in regard to all matters concerning the New York extension, coolly demanded a preliminary sum of $50,000. This sort of blackmail the company refused to endure, and took the matter into the courts, which there is little doubt will order the delivery of the property to its real owners.

Lake Temiscouata.—Eighteen hundred hands are grading this Canadian line between Edmunston and Riviere Du Loup, a distance of about 80 miles.

New York City & Harlem.—In accordance with the recent act of the Legislature, work is to begin soon on lowering the tracks of this road in the Annexed District (the portion of New York City north of the Harlem river.) The tracks will be lowered from 7 to 10 ft., and the general character of the work will be similar to the line of the New York Central from the Harlem river to the Grand Central depot. It is expected that the work when completed will require a tunnel under the Harlem instead of the present bridge.

Grand Trunk.—Tracklaying is making good progress on the lines from Fort Covington, N. Y., to Massena Springs, the terminus of a branch of the Rome, Watertown & Ogdensburgh.

Sebasticook & Moosehead Lake.—This Maine line will be mortgaged to raise funds to complete the road to Greenville.

Canadian Pacific.—The Montreal & Smith's Falls Short Line will be opened for business the first of next month. The grading, alignment, and general character of work is said to be the best on any Canadian line.

Pittsburg & Lake Erie.—A meeting of the stockholders is to be held Aug. 9 to consider the construction of a short line in Mahoning county, O.

Pittsburg & Western.—Work is in progress repairing the line and changing the gauge of the Pittsburg, Painesville & Fairport road from Niles to Youngstown O., a distance of 11 miles. It is rumored that a scheme is in progress for uniting the Pittsburg & Western and the Buffalo, Rochester & Pittsburg with the New York, Lake Erie & Western.

York Harbor & Beach.—This Maine line will be open for traffic Aug. 8.

New York, New Haven & Hartford.—It is currently reported that this company will build a line to parallel the Derby road, now that the New York & New England has secured the entrance to New Haven. The line will be built from Derby to Woodmont, and has already been surveyed.

Ottawa, Waddington & New York.—Ground was broken on this line at Morrisburgh, Ontario, July 27. It is reported that this line is connected with the New York Northern railroad, proposed from Schenectady to Ogdensburgh.

New Projects and Surveys.—*Boston & Quebec Air Line.*—The Maine Railroad Commissioners have refused to approve the location of this line on the ground that the surveys cover only a small part of the proposed line. A new survey is in progress.

Clinton County.—A survey is in progress for a rail road from Westport, Pa., on the Philadelphia & Erie railroad, northwest 25 miles, to develop coal and timber lands. A. H. MANN, Williamsport, Pa., is interested.

Wiscasset & Boothbay.—There is talk of a railroad between these places on the coast of Maine.

Brant Rock.—A railway line is proposed from Marshfield, Plymouth county, Mass., on the Old Colony, to Brant Rock and Duxbury Beach, about eight miles.

Buffalo & Geneva.—This proposed line in western New York is to be placed under survey at once. The road will extend from Buffalo to Geneva, 205 miles, connecting at the latter point with the Lehigh Valley, in whose interest, it is rumored, the project is being pushed. WILSON S. BISSELL is President, and E. M. LEUFFER, Chief Engineer.

Southern.

Existing Roads.—*Chattanooga, Rome & Carrollton.* It is reported that financial arrangements have been completed which will result in the resumption of active work on this road.

Rome & Decatur.—It is stated that this line will open for business to Cedar Bluff by Aug. 30, and to Gadsden by Sept. 10.

Charleston, Cincinnati & Chicago.—The engineers are at work on the partially graded line of the Georgia & Carolina Midland between Augusta, Ga., and Newberry, N. C. The old grade was for a narrow gauge road, but the new line will be standard gauge with easier alignment and grades.

Kentucky Union.—The company have altered their

original proposition and now propose to build 75 miles from Lexington.

Elizabethtown & Hodgenville.—Grading is at last under way on this Kentucky road.

Marietta & North Georgia.—There is much opposition in the Legislature to the bill permitting the company to extend its line from Marietta to Atlanta.

New Projects and Surveys.—*Carolina, Cumberland & Chicago.*—This road is projected from Aiken, S. C., *via* Abbeville, Asheville, and Cumberland Gap, to Lexington, Ky., a distance of 400 miles. Forty-seven miles have been graded in South Carolina and surveys have been made to Asheville. R. E. BOWEN, Briggs, S. C., is President.

Orangeburgh & Lewiedale.—This short line in Orangeburgh county, S. C., has been surveyed and will be put under contract by next January. The Eutawville Railroad, which is under the same management, now runs to Elloree, and contracts are let for the bridge and trestle over the Santee river. The surveys are completed to Sumter. R. C. BARKLEY is President of both roads, and H. T. PEAKE is Chief Engineer.

Suwanee & Gulf.—This road is projected from Cedar Key, Fla., north 250 miles to Millen, Ga. Sixty miles of the right of way is secured, and the engineers will take the field Oct. 1. D. B. DUNN is Chief Engineer and JAS. O. ANDREWS of Cedar Key is Secretary.

Sheffield & Seaboard.—A preliminary survey is just completed of this road from Sheffield, Ala., to Aberdeen, Miss., and a second line is being run. The distance is about 95 miles. A good part of the right of way is secured and contracts will be let in the fall. ALFRED H. MOSES, Sheffield, Ala., is President, and BELTON MICKLE is Chief Engineer.

Tombigbee.—This line is projected from Columbus, Miss., to Decatur, Ala., about 130 miles. Preliminary surveys have been made and right of way is being secured. B. A. VAUGHN, Columbus, Miss., is President, and W. J. KELLY, Chief Engineer.

Chattanooga Southern.—This company has been organized in Georgia. WM. CRUTCHFIELD is President; J. C. HENDERSON, of Chattanooga is interested.

Birmingham, Georgia & Florida.—The engineers are surveying a line from Bainbridge, Ga., to Concord, Fla.

The Northwest.

Existing Roads.—*Chicago & Eastern Illinois.*—A branch is to be built from Momence to Goodland on the Chicago & Indiana Coal line, about 35 miles. This will give the latter line an outlet to Chicago independent of the Louisville, New Albany & Chicago, whose track it at present uses from Fair Oaks.

St. Paul, Minneapolis & Manitoba.—The tracklaying on the Great Falls extension, which has been somewhat retarded by heavy rains, is now being pushed at an unprecedented rate. The following is the progress record ending July 16:

	Miles.
On Saturday, July 16	7.20
Week ending Saturday, July 16, six days (within 1,000 ft. of 30 miles)	29.81
Thirty days ending July 16, (one entire day lost by rain)	103.80

These distances far surpass any previous record of tracklaying from one end. In the rapid construction on the Canadian Pacific the highest record was as follows:

	Miles.
For one day	6.38
For one week	24.62
For month of July, 1883, thirty-one days	92.35

It is reported that a line is being surveyed from Hinckley to Duluth.—The city of Bismarck, Dak., is on the *qui vive* to know whether the company intends to build to that point this year.

Illinois Central.—The lines from Cherokee to Onawa, Ia., 80 miles, and from Cherokee to Sioux Falls, Dak., are under contract and will be pushed to early completion. It is also rumored that the company will soon enter upon farther extension in Dakota.

Red River Valley.—The grading is rapidly progressing on this line. It is rumored that the Dominion government will obstruct the work by refusing the right of way across the Dufferin farm and other government lands along the route. It is stated that the owners of the Manitoba & Northwestern are very much interested in the construction of the new line as it will give them an outlet independent of the Canadian Pacific, and that work is to be pushed on the extension of the road, which is projected to the base of the Rocky Mountains, 430 miles from Winnipeg.

Alberta & Arthabaska.—Location is reported finished on this road and grading is to begin at once.

Wisconsin Central.—The surveys are nearly complete of the line from Abbotsford to Merrill, Wis. The line will be 70 miles in length and contracts will be let about Aug. 20. It is also stated that a line will be run from Wausau to Rib Lake.

Missouri Pacific.—The line to Nebraska City has been opened for business.

Duluth & Iron Range.—Surveys are in progress on the proposed extension from Tower, Minn., east 30 miles.

Fremont, Elkhorn & Missouri Valley.—The graders are making good progress on the Black Hills extension from Rapid City to Whitewood. The branch from Whitewood to Deadwood is under survey, but will not be built this season.

Northern Pacific.—The Duluth & Manitoba line is being pushed toward the Canadian boundary from Grand Forks at a rapid rate, and it is hoped to reach the Red River Valley connection by Sept. 1. It is rumored to be the ultimate intention of the managers to build a line to Fort Buford, north of and parallel to the Manitoba.

Chicago, Milwaukee & St. Paul.—The surveyors of the Nebraska Central are running the line from Omaha northwest. At last accounts they were near Madison.

New Projects & Surveys.—*Lake Superior & Southwestern.* This company has been organized at Austin, Minn. A. KNOX is President.

Winona & Southwestern.—JOHN WILLIAMS is Chief Engineer of this Minnesota company, and will begin preliminary surveys at once.

Three Falls.—The surveyors have begun work on this line from Walnut Grove, Minn.

Paducah & Mt. Vernon.—E. C. RICE, Chief Engineer, has finished a preliminary survey for this Illinois road.

Omaha & Yankton.—HARVEY N. SHEPARD, of Boston, is to take hold of this Nebraska project, and it seems likely that, as the towns along the proposed line are willing to give liberal aid, the scheme may soon be put on a sound basis.

Duluth & Mackinaw.—It is given out on the authority of a Detroit scribe that the present trip of Gen. ALGER, CHAUNCY M. DEPEW and HENRY B. LEDYARD to Europe, is for the sole purpose of placing $7,000,000 of bonds for a new railroad line with English capitalists. This line is to be built from Duluth to the Straits of Mackinaw, connecting at the former point with the Northern Pacific and at the latter with the Michigan Central. With these companies, contracts and agreements have been perfected that will establish a through transcontinental route over the three lines which will be an important competitor to the new Sault Ste. Marie route.

The Southwest.

Existing Roads.—*Atchison, Topeka & Santa Fé.* The line from Colony to Yates Center is now open for business. The line through Fort Scott is being located. Work is in progress on the extensive yards and sidings at Arkansas City, and will begin soon on the shops at that point. A number of iron bridges are to be erected on the recently opened Leavenworth Northern & Southern. The usual weekly rumor comes from Topeka that the control has been secured of the St. Louis & San Francisco.

Missouri Pacific.—On the Denver, Memphis & Atlantic division, the tracklaying is being pushed from Dexter to Arkansas City, and will be completed by the middle of August. The Kansas, Nebraska & Dakota line is to be straightened between Topeka and Fort Scott and the extension from Topeka up the Kaw river is under survey *via* Wamego, St. Mary's and Westmoreland.

St. Louis & San Francisco.—The grading is practically complete on the Kansas Midland line between Wichita and Ellsworth, 103 miles. It is stated that the Texas line will be built south to Terrell to connect with the Texas Central.

Cape Girardeau & Southwestern.—A survey has been made of the extension from Wappapello to Greenville, Wayne county, Mo.

Central Missouri.—The first spike on this road was driven at St. Charles, Mo., July 19, by Mrs. J. T. K. HAYWARD, wife of the General Superintendent. The spike was of solid silver, engraved with an appropriate inscription, and was presented to Mrs. HAYWARD by WARREN H. LOSS & Co., the chief contractors.

Chicago, Milwaukee & St. Paul.—The Kansas City extension will be completed by Oct. 1.

St. Joseph & St. Louis.—The four miles of abandoned track between North Lexington and Lexington, Mo., have been put in good repair and trains are now running over it.

Chicago & Alton.—The proposed line from Bowling Green, Mo., to Little Rock, Ark., is said to be a scheme of this company.

New Projects and Surveys.—*Rulo, Hiawatha & Southern.*—A meeting was recently held at St. Joseph, Mo., to consider the feasibility of extending this projected road from Rulo, Neb., east *via* Graham and Maryville, to Parnell City on the Chicago, St. Paul & Kansas City road now under construction.

Little Rock & Hot Springs.—ARCHIBALD FARLEY, an English capitalist, is examining the status of this Arkansas project; and if satisfied with its prospects, will furnish the necessary funds for building.

Rocky Mountain and Pacific.

Arizona Mineral Belt.—Track is laid on the road, 22 miles from Flagstaff, and the grading is finished for 30 miles farther.

Chicago, Rock Island & Pacific.—A rumor is current that this company has had an exploring party out, looking for a feasible route to the Pacific coast between the Atlantic & Pacific and Central Pacific lines; and that they have reported a line running from a point near Fort Wingate, N. M., crossing the Colorado river above the Grand Cañon, and running *via* Pioche, Tybo, Owens, King's Pass, Tulare lake and the San Joachim valley to the coast.

Coeur d' Alene Ry. & Nav. Co.—Trains are now running on this Idaho line from Mission, at the head of navigation on the Coeur d' Alene river, to Osborne, 20 miles.

Burlington & Missouri River.—The people of the booming city of Denver, Col., have become so much excited over the prospect of this company building its Pacific extension from Fort Collins west across the mountains, and leaving Denver only a "way station" on a branch line that the Chamber of Commerce has addressed a protest to President PARKINS and threatened the perennial enmity of the Denverites if the arrangement was carried out. The President's reply stated that "no definite plan for an extension beyond the range had been matured."

Southern Pacific.—The scarcity of material is retarding construction on some of the extensions in southern California. The Capay Valley line is being graded, and work is to begin at once on the Santa Rosa & Benicia.

Atchison Topeka & Santa Fé.—It is again strongly stated that this company is behind the Colorado Midland line, and also that an offensive and defensive alliance has been made with Gen. PALMER of the Denver & Rio Grande Western. This story would seem more probable if the latter line were not a narrow gauge, and if its terminus were at some other place than Ogden, Utah.

Bridges and Canals, Etc.

Quebec Railway Bridge Co.—The following have been appointed provisional directors: Hon. J. G. Ross Col. RHODES, R. R. DOBELL, Hon. THOS. MCGREEVY J.B. FORSYTH, G. LEMOINE, E. CHINIC, H. M. PRICE, J. I. TARTE and CY. DUQUET. Col. RHODES was elected President. The stock books have been opened.

The Burlington & Illinois Bridge Co. has been incorporated at Burlington, Ia., with a capital stock of $30,000 and privilege to increase to $75,000. President, PHILIP M. CRAPO; Vice President, J. W. GILBERT; Secretary, CHAS. W. RAND. The company will build a wagon and railroad bridge over the Missouri.

Chenango Canal.—The city of Utica, N. Y., has been authorized to fill in the canal and the ground will be divided into lots and sold.

Bridge Notes.—Boston, Mass. The New York & New England R. R. Co. will build a new bridge across Quincy street in Dorchester. The city will pay half the cost. ——Worcester, Mass. Horace A. Bigelow proposes to build a bridge across Lake Quinsigamond to Shrewsbury at a cost of $100,000. ——Taunton, Mass. The city will build an iron bridge across the river at the pumping station, at a cost not to exceed $7,000. The water mains will be moved from the river bed and laid on the bridge. ——Hartford, Conn. The New York & New England R. R. Co. is building an iron bridge across the Connecticut river to replace the old wooden bridge. ——Poughkeepsie, N. Y. The east shore cantilever arm is completed and the false work for the west shore arm is being erected. Half of the bridge, between Pier 3 in the river and the west anchorage pier will be completed in November. ——Cedarville, N. J. The Cumberland County Freeholders will build a new bridge. ——Chicago, Ill. The city has made arrangements by which the Pittsburg, Fort Wayne & Chicago R. R. Co. will build 4 more viaducts. ——The Indiana, Bloomington & Western R. R. Co. will build 3 new iron bridges on the Ohio Southern line and one near Columbus, O.: the spans are from 130 to 300 ft. ——Indianapolis, Ind. The Union Railway Co. will proceed at once with the erection of the viaduct. ——Nebraska City, Neb. The new bridge of the C. B. & Q. R. R. will be commenced at once, and is to be completed by January next. B. CROSBY is the engineer in charge. There will be two spans of 400 ft. each, and one of 350 ft., with long trestle approaches. ——Omaha, Neb. The plans for the highway and railroad bridge have been approved by the Secretary of War. The Burlington & Missouri River R. R. Co. will build an iron bridge across Seventh street. ——Butte City, Mont. The California Bridge Co. will raise the bridge which fell into the river last winter. ——The St. Anne's bridge on the Smiths Falls Short line (Ontario) will soon be completed; there are 5 lattice girder and 8 plate girder spans and a Pratt truss. The Union Bridge Co. has built 7 of the bridges on this line, and Mr. T. J. SULLIVAN, the Superintendent, states that the erection of the truss span over the St. Anne's rapids is the most difficult and dangerous piece of bridge work he has ever undertaken. ——Fredericton, N. B. The Dominion Bridge Co. will build the steel bridge across the St. John river.